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PROGRAM AND ABSTRACTS OF THE ELEVENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF PARASITOLOGISTS

ST. LOUIS, MISSOURI

DECEMBER 31, 1935, JANUARY 1 AND 2, 1936

PROGRAM[1]

TUESDAY MORNING SESSION, DECEMBER 31, 10:00 A. M.; ROOM 3802, NORTH BUILDING, WASHINGTON UNIVERSITY MEDICAL SCHOOL.

Read

1. Experiments and Observations upon a Malarial Parasite Not Restricted to Living in Erythrocytes. (15 min.) (Lantern.) (Also by demonstration.) Clay G. Huff and William Bloom, University of Chicago.

2. The Endogenous Phases of the Life-cycle of *Eimeria miyairii*, Coccidian Parasite of the Rat. (15 min.) (Lantern.) Robert L. Roudabush, Iowa State College.

3. Some Effects of Diet on the Quantitative Character of the Coccidian Infection of the Rat. (10 min.) (Lantern.) E. R. Becker and N. F. Morehouse, Iowa State College.

4. Studies on Intestinal Parasites among Rats Caught in Saint Louis. (12 min.) H. Tsuchiya and L. E. Rector, Washington University.

5. A Helminthological Survey of 1,315 Dogs from New Orleans. (12 min.) (Lantern.) Dan D. Baker and E. Harold Hinman, Louisiana State University.

6. The Epidemiology of Human Ascariasis in the Metropolitan Area of New Orleans, Louisiana. (15 min.) William H. Headlee, Tulane University and Purdue University.

7. Resistance in Mice to *Ancylostoma caninum*. (15 min.) K. B. Kerr, Johns Hopkins University.

8. Studies on Ascarid Nutrition. (10 min.) (Lantern.) J. E. Ackert and J. H. Whitlock, Kansas State College.

By Title

9. The Status of *Plasmodium capistrani* (Russell). Reginald D. Manwell, Syracuse University.

10. Further Studies on the Amoebae Parasitic in Opalinid Ciliate Protozoans. T. T. Chen and R. M. Stabler, Yale University and University of Pennsylvania.

11. The Persistence of Immunity of the Chicken to the Protozoan Parasite *Eimeria tenella*. C. A. Herrick, University of Wisconsin.

12. Acquired Immunity in *Trichomonas foetus* Infection of Cattle. Justin Andrews, Fred W. Miller and Charles W. Rees, Johns Hopkins University and the U. S. Bureaus of Dairy Industry and Animal Industry.

13. The Macronuclear Chromatin of *Nyctotherus ovalis*. R. R. Kudo, University of Illinois.

[1] An alphabetical author index will be found at the end of the program.

14. A Clinical Survey of Vincent's Angina. Timothy L. Duggan, Loyola University, New Orleans. (Introduced by John G. Arnold, Jr.)

15. A Note on the Staining of Acid Fast Bacteria. Edmond L. Merilh, Loyola University, New Orleans. (Introduced by John G. Arnold, Jr.)

16. A Note on the Prevalence of Nematodes in Human Appendices. William A. Roy, Loyola University, New Orleans. (Introduced by John G. Arnold, Jr.)

17. Factors in the Epidemiology of Hookworm in Egypt. J. Allen Scott, Rockefeller Foundation and Department of Public Health, Cairo, Egypt.

18. Infectivity of *Trichinella spiralis* after Successive Feedings to Rabbits. Joseph E. Alicata, U. S. Bureau of Animal Industry.

19. Parasitic Fauna of Birds Found Dead on the Washington Monument Ground During the 1935 Autumnal Migration. Allen McIntosh and Gertrude E. McIntosh, U. S. Bureau of Animal Industry.

20. A Survey of the Parasites of North American Rabbits. John G. Arnold, Jr., Loyola University, New Orleans.

21. Experimental Infections and Superinfections of Pigs with Lungworms. Benjamin Schwartz and John T. Lucker, U. S. Bureau of Animal Industry.

22. Single Larva Infections of *Strongyloides ratti* Sandground, 1925, as an Approach to Certain Problems of *Strongyloides* Bionomics. George L. Graham, Rockefeller Institute, Princeton, N. J.

23. The Blood Picture of Normal and Trichinized White Rabbits. Wayne W. Wantland, Northwestern University.

24. The Relation of Vitamin A Deficiency to Ascariasis in the Dog. Willard H. Wright, U. S. Bureau of Animal Industry.

TUESDAY AFTERNOON SESSION, DECEMBER 31, 2:00 P. M.; ROOM 3802, NORTH BUILDING, WASHINGTON UNIVERSITY MEDICAL SCHOOL.

Read

25. Double Infestations of Snails with the Cercariae of Digenetic Trematodes. (15 min.) (Lantern.) (Charts.) W. W. Cort, D. B. McMullen and Sterling Brackett, Johns Hopkins University, Monmouth College and University of Minnesota.

26. The Life Cycle of *Cercariaeum lintoni* Miller and Northrup. (10 min.) (Chart.) Ben Glading, University of California. (Read by Datus M. Hammond.)

27. A Method for Transplanting Adult Trematodes. (5 min.) Paul Beaver, University of Illinois and Oak Park Junior College. (Introduced by Secretary of A. S. P.)

28. A Note on the Life History of *Mosesia chordeilesia* n. sp. (Lecithodendriidae). (10 min.) (Lantern.) Donald B. McMillan, Monmouth College.

29. A Study of the Endoparasitic Trematodes from Marine Fishes of Departure Bay, B. C. (10 min.) Samuel H. McFarlane, Aurora College. (Introduced by H. J. Van Cleave.)

30. The Life History of *Cotylophoron cotylophorum*, a Trematode from Ruminants. (15 min.) (Opaque Projection.) (Also by demonstration.) Harry J. Bennett, Louisiana State University.

31. New Aspidogastrid Species, with a Consideration of the Systematic Position of the Group. (10 min.) (Lantern.) Ernest C. Faust and Chung-Chang Tang, Tulane University and Fukien Science Institute.

32. The Larval Stages of Acanthocephala. (10 min.) Harley J. Van Cleave, University of Illinois.

By Title

33. Characteristic Movements of the Miracidia and Cercariae of the Human Schistosomes of Egypt. C. H. Barlow, Rockefeller Foundation and Public Health Laboratories, Cairo, Egypt.

34. Three New Species of Larval Trematodes from Kentucky. R. M. Cable, Berea College and Purdue University.

35. *Parorchis avitus* (Linton, 1914), a Synonym of *P. acanthus* (Nicoll, 1906). R. M. Cable and W. E. Martin, Purdue University.

36. The Finer Structure of the Body Wall and Parenchyma of Digenetic Trematodes. Theron O. Odlaug, New York University. (Introduced by H. W. Stunkard.)

37. A Restudy of Stafford's Types of the Trematode Genera *Lechriorchis* and *Zeugorchis*. E. W. Price, U. S. Bureau of Animal Industry.

38. Two New Species of *Paralecithodendrium* from Bats. Ralph W. Macy, College of St. Thomas.

39. Some Tropical Fishes as Hosts for the Metacercaria of *Clinostomum marginatum*. R. F. Nigrelli, New York Aquarium and New York University.

40. Experiments on the Control of *Epibdella melleni* MacCallum, a Monogenetic Trematode of Marine Fishes. R. F. Nigrelli, New York Aquarium and New York University.

41. On the Effect of Fish Mucus on *Epibdella melleni*, a Monogenetic Trematode of Marine Fishes. R. F. Nigrelli, New York Aquarium and New York University.

42. Studies on the Acquired Immunity of the Pompano, *Trachinotus carolinus*, to *Epibdella melleni*. R. F. Nigrelli, New York Aquarium and New York University.

43. Studies on North American Gyrodactyloidea. Justus F. Mueller, New York State College of Forestry.

WEDNESDAY MORNING SESSION, JANUARY 1, 10:00 A. M.; ROOM 3802, NORTH BUILDING, WASHINGTON UIVERSITY MEDICAL SCHOOL.

JOINT PROGRAM WITH SECTIONS F AND N OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

44. The Course of Infection of *Trypanosoma duttoni* in Normal and in Splenectomized and Blockaded Mice. (15 min.) (Lantern.) William H. Taliaferro and Yelena Pavlinova, University of Chicago.

45. The Whole Life Cycle of *Strongyloides*. (15 min.) (Lantern.) Ernest C. Faust, Tulane University.

46. *Ornithodorus hermsi* Wheeler as a Vector of Relapsing Fever in California. (15 min.) (Lantern.) W. B. Herms and C. M. Wheeler, University of California.

47. Complement Fixation Tests on Monkeys Infected with *Endamoeba histolytica*. (15 min.) (Lantern.) William W. Frye and Henry E. Meleney, Vanderbilt University.

Presidential Address, 11: 30 A. M.

48. Some Unsolved Problems in the Parasitology of Amebiasis. Col. Charles F. Craig, Tulane University.

WEDNESDAY NOON, JANUARY 1.

12:30 PARASITOLOGISTS' LUNCHEON, for members and guests.

1:30 ANNUAL BUSINESS MEETING.

WEDNESDAY AFTERNOON SESSION, JANUARY 1, 3:00 P. M.; ROOM 3808, NORTH BUILDING, WASHINGTON UNIVERSITY MEDICAL SCHOOL.

By Demonstration

1. Experiments and Observations upon a Malarial Parasite Not Restricted to Living in Erythrocytes. (Also read.) Clay G. Huff and William Bloom, University of Chicago.

30. The Life History of *Cotylophoron cotylophorum*, a Trematode from Ruminants. Harry J. Bennett, Louisiana State University.

49. Some Blood Parasites from Eastern Nebraska Vertebrates. G. Robert Coatney, Peru State Teachers' College.

50. Filarial Parasites of the Monkeys of Panama. O. R. McCoy, University of Rochester.

51. Effect of Parathyroid Extract (Lilly) and Calcium Lactate on Trichinized White Rabbits. Wayne W. Wantland, Northwestern University.

52. *Cercaria kentuckiensis,* n. sp., First Representative of the "Vivax" Group Known to Occur in the United States. R. M. Cable, Berea College and Purdue University.

53. Acanthocephala of the Burbot "Eel," *Lota vulgaris.* Helen L. Ward, Purdue University. (Introduced by R. M. Cable.)

54. The Study of Metacercariae as an Approach to Life History Problems. Sewell H. Hopkins, A. and M. College of Texas.

55. Further Occurrence of Lymph Vessels in Distomes. H. W. Manter, University of Nebraska.

56. *Polystoma integerrimum nearcticum* n. subsp. from the Urinary Bladder, Genital Ducts, Kidneys and Gills of *Hyla versicolor* LeConte. Allard A. Paul, New York University.

57. Ants as Intermediate Hosts for Two Species of *Raillietina* Parasitic in Chickens. Myrna F. Jones and Margery W. Horsfall, U. S. Bureau of Animal Industry.

58. On the *Diphyllobothrium* of Yellowstone Park. (Also read.) John W. Scott, University of Wyoming.

THURSDAY MORNING SESSION, JANUARY 2, 10:00 A. M., ROOM 3802, NORTH BUILDING, WASHINGTON UNIVERSITY MEDICAL SCHOOL.

Read

58. On the *Diphyllobothrium* of Yellowstone Park. (15 min.) (Lantern.) (Also by demonstration.) John W. Scott, University of Wyoming.

59. Human Infestation with the Dwarf Tapeworm, *Hymenolepis nana,* in Southern United States. (10 min.) G. F. Otto, Johns Hopkins University.

60. Epidemiologic Determinations Concerning *Moniezia expansa* in sheep. (15 min.) (Lantern.) Norman R. Stoll, Rockefeller Institute, Princeton, N. J.

61. Six Years' Intensive Observation of the Seasonal Prevalence of a Tick Population in Western Montana. (10 min.) (Lantern.) C. B. Philip, Rocky Mountain Laboratory, U. S. Public Health Service.

62. The Western Dog Tick, *Dermacentor occidentalis* Neum., a Vector of Bovine Anaplasmosis in California. (15 min.) (Lantern.) W. B. Herms and D. E. Howell, University of California.

By Title

63. A Study of the Anoplocephaline Cestodes of North American Rabbits. John G. Arnold, Jr., New York University and Loyola University, New Orleans.

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ABSTRACTS

1. *Experiments and Observations upon a Malarial Parasite Not Restricted to Living in Erythrocytes.* CLAY G. HUFF and WILLIAM BLOOM, University of Chicago.

Plasmodium elongatum has been studied in various parts of the world and employed as a laboratory strain for some time, but we have only recently discovered that the asexual stages of this parasite may develop in all of the blood and blood-forming cells of the canary. In the hemopoietic organs about 40% of the parasites were found in polychromatophil erythroblasts, about 30% in basophil erythroblasts, 20% in hemocytoblasts, and smaller percentages in the following cell types, in the order named: macrophages, normoblasts, monocytes, plasma cells, thrombocytes, erythrocytes, and cells of the myelocyte series. Gametocytes are found only in normoblasts and erythrocytes. Pigment is produced by the parasites only when they live in cells containing hemoglobin; the polychromatophil erythroblast being the earliest cell of the erythrocyte series in which pigment is produced. The monocytes, macrophages, and granular leukocytes sometimes appear to exert a deleterious action on the infecting parasites. However, many normal looking parasites occur in these cells. The parasites seem to be able to live in all of the other types of cells without being harmed by the cell. The parasites exerted no recognizable inimical influence on any of the cell types. The merozoites are elongate, resembling those of coccidia. There is a quotidian periodicity in the segmentation of asexual forms; the peak of segmentation coming between 8:00 and 10:00 A. M. This parasite, unlike the other avian *Plasmodia*, is capable of living at least forty-eight hours in tissue cultures of the bone marrow.

2. *The Endogenous Phases of the Life-cycle of* Eimeria miyairii, *Coccidian Parasite of the Rat.* ROBERT L. ROUDABUSH, Iowa State College.

Sporozoites may live in the intestine of the host for four days; thus giving an actual continuous infection for that period. One and one-half days after infective feeding the first generation merozoites have matured. These have a length of 8.59 μ and width of 1.64 μ and 20–36 are produced in one group. The second generation appears at two days. These number 10–14 in one group and are 14.36 μ in length and 1.24 μ in width. Third generation appears at three days and number 12–16 and are 19.0 μ in length and 1.19 μ in width. Fourth generation appears at four days and number 36–60; length and width being 5.56 μ and 1.35 μ, respectively. Young micro- and macrogametocytes are first apparent at about five days. These mature at seven days and are thrown off. Thus the pre-patent period is seven days. Since infection has been taking place for four days even after a single infection, the cysts continue to be eliminated until the eleventh day, thus making the patent period four days. The endogenous cycle of the parasite is self-limited as shown by the definite cycle. The fact that when merozoites, taken out of the intestine of one rat after having been infected for five days, are placed in a second rat the cysts are eliminated in two days also lends proof that the cycle is self-limited.

3. *Some Effects of Diet on the Quantitative Character of the Coccidian Infection in the Rat.* E. R. BECKER and N. F. MOREHOUSE, Iowa State College.

4. *Studies on Intestinal Parasites Among Rats Caught in Saint Louis.* H. TSUCHIYA and L. E. RECTOR, Washington University.

One hundred rats were caught at 16 different locations in the city and studies made on the incidence and sites of localization of intestinal parasites in these animals. The number of intestinal parasites per rat ranged from one to several, the triple infections being most common. Among the intestinal protozoa, the incidence of *Hexamitus muris* and *Giardia muris* was found to be very high, and this was followed in order of frequency by *Trichomonas muris* and others. Two instances of *Endamoeba histolytica* were also noted. The optimum sites of localization for

Giardias were found to be the duodenum and jejunum, though variable according to whether the stomachs were empty or full. In one instance *Trichomonas muris* was present in the ileum. In the sections of diaphragms there were 11 instances of *Sarcocystis muris*. Among the helminths, *Strongyloides ratti, Hymenolepis nana, Hymenolepis diminuta, Syphacia obvelata* and *Trichocephalus muris* appeared in order of frequency. *Cysticercus fasciolaris* were present in about three-fourths of the livers examined. In several rats there were *Trichinella spiralis,* and in one of which adults were found in the small intestine whereas no larvae were detectable elsewhere.

5. *A Helminthological Survey of 1315 Dogs from New Orleans.* DAN D. BAKER and E. HAROLD HINMAN, Louisiana State University.

In conjunction with studies upon the suprarenal glands of dogs a helminthological survey of 1315 animals, freshly autopsied, was made. Incidence of parasites was recorded according to sex, maturity, weight and breed of animal and season. Maturity was determined by examination of gross sections of the ovaries and females, whose ovaries contained only small follicles and no corpora lutea, were considered to be immature. In the male, maturity was determined by a consideration of the weight, coat and breed and in many cases smears were made from the epididymis. From a correlation of maturity of the animal with the parasites, data has been obtained concerning age resistance to certain of these infections.

6. *The Epidemiology of Human Ascariasis in the Metropolitan Area of New Orleans, Louisiana.* WILLIAM HUGH HEADLEE, Tulane University and Purdue University.

An analysis of the results of stool examinations of 10,990 individuals of metropolitan New Orleans, largely from the clinic population of the area, showed an incidence of 6.6 per cent *Ascaris lumbricoides.* The incidence was considerably higher in the children of pre-school age. The distribution was general, with a tendency for areas of concentration to be formed. Detailed studies were made of 74 environments involving 79 families. Gross pollution, as evidenced by the presence of stools, was found in only a few environments, but soil isolations showed that 75 per cent of these environments had been polluted. Approximately half of all Ascaris ova isolated contained motile larvae, these being isolated in numbers from some environments. The environments inhabited by Negro families were more heavily infested than were those inhabited by white families. There was a correlation between the incidence of infection of the individuals, the incidence of infested environments, and the type of provision for the disposal of excreta. Physical and climatic conditions were such that a considerable soil infestation resulted from a minimum amount of pollution. Natural agents, such as heavy rains, and also the habits of the people, such as defecation, personal hygiene, and play, were favorable for the dissemination and propagation of ascariasis. Economic conditions which are instrumental in causing a crowding of the population and frequent change of residence, were important factors in the dissemination of ascariasis. Reinfection of patients after treatment was a common occurrence.

7. *Resistance in Mice to* Ancylostoma caninum. K. B. KERR, Johns Hopkins University.

Mice subjected to an infection of 2500 larvae of the dog hookworm *A. caninum* either through the skin or the mouth died within 7 days after infection. However, it was subsequently found that mice subjected to a series of sublethal infections were rendered resistant to a dose well above the average lethal dose. Fifty-six mice repeatedly infected at weekly intervals with doses increasing in a geometric series starting with 250 larvae each tolerated without effect single doses of 4000 larvae each. This number killed the control mice within 4 days. Continuing the series on 26 of these mice with 8000 and 16,000 larvae it was noted that the resistance began to break when the latter dose was administered. Further experiments showed that

a single infection of 1500 larvae each given by mouth rendered 6 mice resistant to a subsequent infection by mouth of 4000 larvae each given 28 days after the first infection. Five mice were infected by mouth with 275 larvae each. Three of these mice survived a subsequent infection of 4000 larvae each given by mouth 21 days later. Five mice were repeatedly infected at weekly intervals with about 50 larvae each for 5 weeks (an average of 251 larvae each). Two of these mice survived a subsequent infection with 4000 larvae. Attempts to passively transfer this resistance gave entirely negative results.

8. *Studies on Ascarid Nutrition.* J. E. ACKERT and J. H. WHITLOCK, Kansas State College.

A critical review of the literature on ascarid nutrition indicates that the method of feeding and the metabolism of the Ascaridae do not differ fundamentally from those of other animals. The present studies were made upon the roundworm, *Ascaridia lineata* (Schneider), with young growing chickens as hosts. All birds were parasitized with the same numbers of embryonated eggs of the nematode after which one group of chickens was continued on the regular ration whereas the other group was maintained on glucose or other nutriments administered intramuscularly, subcutaneously, intravenously or intraperitoneally. Drinking water was kept constantly before all of the chickens. At the close of a given period all birds under comparison were killed, and the nematodes collected, counted and measured. Comparisons were then made on the average number and length of the *A. lineata* from the two groups. The results of the tests upon 141 chickens showed that during the first 18 days there was little difference between the groups; but that after this period when the worms have withdrawn from the intestinal wall into the gut lumen, the worms from the normally fed chickens were more numerous and longer than those from the fowls that were fed parenterally.

9. *The Status of* Plasmodium capistrani (*Russell*). REGINALD D. MANWELL, Syracuse University.

Plasmodium capistrani was isolated by Russell from the island painted quail, *Excalfactoria lineata,* of the Philippine Islands and described in 1932. Through the courtesy of Dr. Russell the author was able to obtain several canaries infected with this parasite in December, 1934, and it has been under observation since. Although it appeared at first to differ from *Plasmodium praecox* (*relictum*) in certain minor respects, such as the character and distribution of pigment in the gametocytes, it has become quite clear that these differences are not constant and that corresponding stages of *praecox* and *capistrani,* both asexual and sexual, are virtually indistinguishable from each other. Twenty-seven pure infections of *Plasmodium capistrani* have been carefully followed, and these too have been found to behave in practically the same way as those of *praecox,* at least as far as the canary is concerned. In order to be more certain as to the identity of these two very similar strains, chronic infections of each were inoculated with massive doses of parasites of the other, and it was found that each gave a very high degree of protection against subsequent infection with the other strain. Chronic infections of *Plasmodium cathemerium* were also inoculated with large doses of *capistrani,* and *vice versa.* Here also a high degree of mutual protection was found to exist, although considerably less marked than when *praecox* and *capistrani* were crossed. A total of nineteen birds (chronic infections) were used in this way, besides eleven controls. The immunological characteristics of *capistrani* appear therefore to be like those of *praecox,* and it is therefore necessary to regard these two strains as of the same species—*praecox* (*relictum*).

10. *Further Studies on the Amoebae Parasitic in Opalinid Ciliate Protozoans.* T. T. CHEN and R. M. STABLER, Yale University and University of Pennsylvania.

Studies on material secured from different parts of the world have shown that the endamoebae parasitic in the opalinids have a very wide geographical distribution,

being found in Egypt (Cairo), China (Nanking and Peiping), the United States (Utah and Arizona), Panama (Panama City), Brazil (São Paulo) and Chile (near Coquimbo). Numerous species belonging to all four genera of the Opalinidae—*Protoopalina, Zelleriella, Cepedea* and *Opalina*—have been found parasitized. Numerous cysts of the opalinids have been observed to harbor amoebae. In some individual anurans, nearly 100% of the cysts are infected. There may be 1–7 amoebae in each cyst, although the majority of the cysts contain only 2–4 amoebae. It is suggested that the presence of the amoebae within the encysted opalinids constitutes an important method of transmission of the amoebae from adult anuran to tadpole.

11. *The Persistence of Immunity of the Chicken to the Protozoan Parasite,* Eimeria tenella. C. A. Herrick, University of Wisconsin.

Chickens two months old were repeatedly infected until their erythrocyte count was not reduced by the infection. They were then kept free from reinfection for a period of one year when they were again given oocysts of *Eimeria tenella.* The number of oocysts given was sufficient to reduce the erythrocyte count of the control approximately 60 per cent but did not affect the erythrocyte count of the chickens previously infected, nor did it affect the egg production of the hens which was approximately 50 per cent during the course of the infection in the control chicken.

12. *Acquired Immunity in* Trichomonas foetus *Infection of Cattle.* Justin Andrews, Johns Hopkins University, Fred W. Miller, U. S. Bureau of Dairy Industry, and Charles W. Rees, U. S. Bureau of Animal Industry.

Epidemiological and experimental observations have been made which suggest that the genital infection with *Trichomonas foetus* (Riedmuller) in heifers is self-limiting, and that the spontaneously recovered animals are refractory to reinfection. Twenty-four yearling heifers were examined at approximately weekly intervals for ten months during which time they were bred for their first calf by family bulls, some of which were observed to harbor the flagellates, all the others of which were probably infected as judged by the subsequent infection of the heifers they served. Heifers were served repeatedly until they became pregnant or were discarded. Vaginal infections usually becoming apparent soon after the first service were observed in 18 of the 24 animals, and it is likely that more were actually infected but may not have been detected due to the lightness and transience of the infection and the limitations of our diagnostic technique. The observed infections lasted for from one to 23 weeks, and in every instance have abated to the point of being diagnostically indetectible. The average number of services for conception has varied directly with the apparent length of the trichomonad infection. In spite of the fact that infected bulls served several of the heifers after they had apparently recovered from their primary infections, none of them developed typical trichomonad infections though in rare instances they were positive for a few days after service. Attempts were made to reinfect three heifers which had recovered spontaneously with material containing motile trichomonads, which in one instance was proved to be infective to a susceptible animal, but none of them developed an infection. The duration of this refractoriness to reinfection is not yet known, nor is it certain that the acquired immunity is sterile or of the nature of premunition.

13. *The Macronuclear Chromatin of* Nyctotherus ovalis. R. R. Kudo, University of Illinois.

This ciliate contains one macronucleus and one micronucleus. The former is composed of a delicate membrane, karyochylema and chromatin spherules, while the latter is a small (less than 10 μ in diameter) vesicular nucleus with a few chromatin spherules. The macronucleus measures 30–70 μ by 30–50 μ by 15–25 μ. The macronuclear chromatin spherules vary in size from a small fraction of a micron up to more than 20 μ in diameter. Larger spherules contain one to many alveoli, in some of which smaller chromatin spherules of variable number occur. These spherules manifest typical chromatin staining with Heidenhain or Delafield and are highly

positive to Feulgen's nucleal reaction. For the nucleal staining, any fixatives may be used. Observations on the effect of the acidified methyl green, 10 per cent sodium chloride solution and pepsin-hydrochloric acid upon these spherules show that they can be looked upon as reliable chromatin "tests." Flemming's strong fluid or 2 per cent osmium tetroxide (in vapor or in solution) fixes the chromatin spherules in original state; absolute alcohol, 0.5 per cent acetic acid, 4 per cent formaldehyde or Carnoy's fluid appear to cause deformity and leave the spherules partially soluble. Judging by the difference in reaction toward Feulgen's nucleal staining as well as nuclear dyes, it seems probable that there is a certain difference in the chemical nature of the chromatin substance present in the resting macronucleus and micronucleus.

14. *A Clinical Survey of Vincent's Angina.* TIMOTHY L. DUGGAN, Loyola University, New Orleans.

This investigation was undertaken to determine the percentage of infection of Vincent's Angina. Patients were studied in various local dental clinics. They were chosen at random and were of various ages. The percentage of infection was correlated with the condition of the mouth.

15. *A Note on the Staining of Acid-Fast Bacteria.* EDMOND L. MERILH, Loyola University, New Orleans.

A modified method for applying the initial stain is discussed in this paper. The stain is heated in small test-tube and then poured on a slide, rather than being heated on the slide. This modification is especially good for class work.

16. *A Note on the Prevalence of Nematodes in Human Appendices.* WILLIAM A. ROY, Loyola University, New Orleans.

The present investigation was undertaken to determine the percentage of nematode infestation in cases of appendectomies. Appendices were obtained from several hospitals, and examined carefully. Parasites present were mounted and identified.

17. *Factors in the Epidemiology of Hookworm in Egypt.* J. ALLEN SCOTT, Rockefeller Foundation and Department of Public Health, Cairo, Egypt.

A study of the distribution of hookworm in Egypt has revealed the following facts: 1. As known for many years, the percentage incidence of infestation is generally high. 2. Certain districts, however, having a very low incidence have been discovered. Furthermore, high incidence villages have been found immediately adjoining low incidence villages. 3. Although Egypt has long been a classic center of hookworm disease, the intensity of infestation is very low. There is no evidence of any great reduction in recent years. As judged by the egg count, relatively few cases have a sufficiently large number of worms to place them in groups of probable clinical significance in the classifications given in the literature, even though due allowance is made for the species concerned, viz. *A. duodenale.* Since, however, this infestation is commonly superimposed on infestations of schistosomes and other parasites, the role of hookworm in the cumulative clinical effect is of undoubted importance. The situation is only partially explained by the hot, arid climate. Two further observations have thrown light on the problem. A study of the defecation habits of the people has shown that soil pollution does not tend to be concentrated in places where intense soil infestation would result. Development of hookworm larvae is completely inhibited in cultures of soils from many common defecation areas. As the effect is independent of the sand or clay content of the soils, the factor involved appears to be of a newly recognized type in the natural control of hookworm. Under these conditions it seems obvious why intense human infestations are not built up, even though a high percentage incidence of low grade infestation is general.

18. *Infectivity of* Trichinella spiralis *After Successive Feedings to Rabbits.* JOSEPH E. ALICATA, U. S. Bureau of Animal Industry.

Experiments were performed which involved the passage of non-lethal doses of trichinae every 32 days from two rabbits to two other rabbits until 7 pairs of rabbits were used. The initial strain of larvae was obtained from experimentally infested guinea pigs. The muscles of rabbits receiving the seventh generation of trichinae were heavily infested with larvae. The virulence of the larvae was not diminished as a result of their passage through rabbits seven times in succession, since a guinea pig and a rat fed lethal doses of these larvae died of intestinal trichinosis 4 days after feeding. During the past 7 years the writer has passed a strain of trichinae from guinea pig to guinea pig about once every two months; on 3 or 4 occasions the strain was passed through a rabbit and again transferred to guinea pigs. The above findings are at variance with those of Bachman and Oliver (1934) who found that a strain of trichinae, passed from rabbit to rabbit 20 days after infection, died after the fifth feeding. Bachman and Oliver assumed that the worms lost their virulence and numbers due to successive passages through rabbits. The present writer is of the opinion that Bachman and Oliver did not allow enough time for sufficient larvae to reach the infective stage in the muscles of the rabbits, and that repeated feedings of fewer and fewer infective larvae to successive rabbits gradually reduced the number of infective larvae, the final feeding being entirely negative.

19. *Parasitic Fauna of Birds Found Dead on the Washington Monument Ground During the 1935 Autumnal Migration.* ALLEN MCINTOSH and GERTRUDE E. MCINTOSH, U. S. Bureau of Animal Industry.

During September and October, 1935, 184 birds, representing 30 species, which had killed themselves by flying against the Washington Monument, Washington, D. C., were examined for parasites. Of these 43 birds, representing 14 species, were parasitized. The results of examinations were as follows: *Vireo olivaceus,* 71 examined, 1 infested with *Leucochloridium dryobates,* 1 with *Prosthogonimus* sp., 1 with *Laterotrema* sp., 1 with acanthocephalids, 2 with *Acuaria* sp., 2 with *Haemaphysalis leporis-palustris; Vireo griseus,* 4 examined, 1 with *Acuaria* sp., 1 with cestodes; *Geothlypis trichas,* 27 examined, 1 with *Urotocus fusiformis,* 1 with *Laterotrema* sp., 1 with acanthocephalids, 2 with cestodes; *Dendroica magnolia,* 23 examined, 5 with *Urotocus fusiformis,* 1 with *Leucochloridium* sp., 10 with cestodes; *Dendroica virens,* 14 examined, 2 with cestodes; *Dendroica castanea,* 2 examined, 1 with *Leucochloridium certhiae,* and with *Prosthogonimus* sp.; *Dendroica tigrina,* 1 examined, cestodes; *Icteria virens,* 8 examined, 1 with troglotrematids, 1 with *Dispharynx* sp., 4 with cestodes; *Compsothlypis americana,* 3 examined, 1 with cestodes; *Oporornis agilis,* 2 examined, 1 with *Leucochloridium mniotiltae; Vermivora ruficapilla,* 1 examined, *Diplotriaena* sp.; *Dumetella carolinensis,* 1 examined, cestodes; *Sphyrapicus varius,* 1 examined, *Leucochloridium certhiae* and *Brachylaemus* sp.; *Colaptes auratus luteus,* 1 examined, cestodes. The following birds were negative: 2 *Vireo philadelphicus,* 1 *Vireo solitarius,* 2 *Dendroica fusca,* 3 *D. striata,* 2 *D. palmarum hypochrysea,* 1 *Mniotilta varia,* 1 *Vermivora peregrina,* 2 *Seiurus aurocapillus,* 2 *Setophaga ruticilla;* 1 *Piranga erythromelas,* 2 *Telmatodytes palustris,* 1 *Cistothorus stellaris,* 1 *Melospiza melodia,* 1 *Spizella pusilla,* 1 *Ammodramus savannarum australis,* 2 *Regulus satrapa.*

20. *A Survey of the Parasites of North American Rabbits.* JOHN G. ARNOLD, JR., Loyola University, New Orleans.

A recent study of two species of North American rabbits revealed numerous parasites. Twenty-three specimens of *Sylvilagus floridanus mallurus* (Thomas) were observed from New York and Pennsylvania. They disclosed one trematode species, one cestode species, and two nematode species. One hundred and fifty-six specimens of *Sylvilagus floridanus alacer* (Bangs) from Kansas were examined. They contained one trematode species, one cestode species, and four nematode species.

21. *Experimental Infections and Superinfections of Pigs with Lungworms.* BENJAMIN SCHWARTZ and JOHN T. LUCKER, U. S. Bureau of Animal Industry.

Four pigs of the same litter were infected experimentally with 2,500, 1,500, 1,000 and 500 larvae of *Metastrongylus elongatus,* respectively, when these host animals were 70 days old. The larvae used were reared in earthworms of the genus *Helodrilus* collected from an area to which swine had no access. The total egg production by the worms harbored by each of the 4 pigs was in inverse proportion to the number of larvae administered, as determined by dilution egg counts made twice a week on 24-hour accumulations of feces. The lungworms of the pigs that received 2,500 and 1,500 larvae, respectively, had strikingly brief patent periods during which relatively few eggs were produced; the lungworms of the remaining 2 pigs had long patent periods with a strikingly large output of eggs. After apparent termination of egg production, each pig was superinfected with a mixed lot of 500 larvae obtained from naturally infested earthworms (*Helodrilus*), the larvae used for superinfection consisting of *M. elongatus* and the related species *Choerostrongylus pudendotectus.* The four pigs were killed about 45 days after superinfection, this period being more than adequate for the development of the lungworms to fertile maturity. The worms found in the lungs of the 2 pigs that received the largest initial infections were practically all juvenile, none of the females of either species containing developing eggs; the remaining 2 pigs harbored sizeable lungworm infestations, many of the females of both species containing eggs in various stages of development.

22. *Single Larva Infections of* Strongyloides ratti *Sandground, 1925, as an Approach to Certain Problems of Strongyloides Bionomics.* GEORGE L. GRAHAM, Rockefeller Institute, Princeton, N. J.

Finding that only a single larva of homogonic development would become a fertile *S. ratti* infection in a rat, simple infections of this type were established and continued serially through eight generations, exclusively homogonic. Thirty-one per cent of 129 rats exposed to a single larva each became positive culturally, more than a third of them on the fifth and sixth days after infection. These forty positive infections indicate that the heterogonic, free-living generation is not necessary in maintaining the parasitic phase of this species. The data of these eight serial generations of *S. ratti* with the single larva technique throw light on two related problems. Obviously, the only possible source for the entrance of a male, contamination excluded, would be through the agency of hyperinfection. In several of the consecutive generations, the single larva transfers to new rats were made so soon after the beginning of patency as to effectively rule out hyperinfection and thereby any hypothetical male. In this study, then, of eight serial generations of *S. ratti,* dioecism has been excluded in both the free and parasitic phases. It would thus appear that the parasitic phase of *S. ratti* is either syngonic, as Sandground concluded, or parthenogenetic.

23. *The Blood Picture of Normal and Trichinized White Rabbits.* WAYNE W. WANTLAND, Northwestern University.

Comparative blood studies were made on a series of twelve white rabbits before and after infection with *Trichinella spiralis.* Each animal was fed from 5,000 to 15,000 larvae. Considerable fluctuation occurred in all factors studied except the osmotic resistance of the erythrocytes. A concentration of 0.460 per cent NaCl in most of the tests was sufficient to prevent laking. The number of erythrocytes was found to range from 4,000,000 to 6,000,000 per cubic millimeter of blood in normal rabbits. Fluctuation of the clotting time (from 2– to 2+ minutes) was noticeable. While fluctuation occurred in the numbers of white cells it was not nearly so marked as in red cell counts. Estimation of hemoglobin revealed fluctuation roughly paralleling that of red cell number. The size of the red corpuscles in normal animals (one hundred cells measured in each case) revealed a constant mode for diameter of 0.006 mm. with the exception of the red cells of one rabbit which revealed a mode for diameter of 0.005 mm. Following infection with *T. spiralis* a definite erythro-

cytosis (in most cases above 7,000,000) was observed in seven of the twelve rabbits infected. In the rabbits in which polycythemia was observed after infection a rise in hemoglobin was also noted. The specific gravity of the blood increased with the rise of hemoglobin and increase in number of erythrocytes. Marked leucocytosis was the rule following infection. Eosinophilia (25–79 per cent) was observed in infected animals. The clotting time fluctuated after, as well as before, infection. From four to six weeks following infection a marked decrease in this factor was observed. Measurements of red cells made from thirteen days to three months and three days after infection showed a definite macrocytosis in ten of the twelve infected animals. The average arithmetical mean diameter increased from 0.00575+ mm. to 0.00609 mm.

24. *The Relation of Vitamin A Deficiency to Ascariasis in the Dog.* WILLARD H. WRIGHT, U. S. Bureau of Animal Industry.

Eleven dogs, from 82 to 154 days old, were maintained on diets partially or totally deficient in vitamin A for periods of 15 to 106 days, during which time the test animals were exposed to natural or artificial superimposed infections with *Toxocara canis* and *Toxascaris leonina.* These dogs harbored post mortem a total of 2674 *T. canis* and *T. leonina,* an average of 243.1 ascarids per animal. Nine control dogs of similar ages on an adequate diet and exposed to the same degree of infestation harbored post mortem a total of 448 ascarids of both species, an average of 49.8 ascarids per dog. The average number of worms per dog on the deficient diet was about 5 times that per dog on a normal diet. The youngest dogs on the totally-deficient diet proved to be markedly susceptible to verminous pneumonia following the invasion of the lungs by ascarid larvae. Dogs on the adequate diet recovered spontaneously from demodectic mange, whereas similarly infected litter mates on a deficient diet failed to respond satisfactorily to treatment. At least two factors seemed to be concerned in the lowered resistance of the dogs on the vitamin A-deficient diet. Diminished secretion of intestinal glands and blocking of their ducts resulted apparently in removing what is believed to be a chemical barrier to the penetration of the larvae. There appeared to be also a lowered activity of the reticulo-endothelial system and a lowered capacity of the granulocytes of the blood to obstruct passage of larvae through the body of the host.

25. *Double Infestations of Snails with the Cercariae of Digenetic Trematodes.* W. W. CORT, Johns Hopkins University, D. B. MCMULLEN, Monmouth College, and STERLING BRACKETT, University of Minnesota.

Examinations of 2526 specimens of *Stagnicola emarginata angulata* from three localities near the University of Michigan Biological Station gave 15 different species of cercariae in 1809 positives, of which 172 contained double infestations with 15 different combinations. Strigeid cercariae were found with other strigeids in five different combinations, the actual numbers of double infestations agreeing closely with what would be expected by chance. The actual number of double infestations in which the one schistosome combined with the strigeids also agreed remarkably closely with chance expectations. There was, however, evidence of some sort of immunity or antagonism between the cercaria of the strigeid *Diplostomum flexicaudum,* which had an incidence of over 40 per cent in the total collections, and three of the other species of cercariae. The cercaria of *D. flexicaudum* was never found in double infestations either with the one echinostome present or with the xiphidiocercaria, *C. polyadena,* although the chance expectations were about 20 and 41 respectively. It was found only five times in double infestations with the commonest of the xiphidiocercariae, when this combination would have been expected about 161 times if it occurred strictly by chance. For all the other possible combinations the number of double infestations actually found either agreed reasonably well with the chance expectations or the incidence of the species was too low to make the data significant.

26. *The Life Cycle of* Cercariaeum lintoni *Miller and Northrup.* BEN GLADING, University of California.

Linton (1915), Miller and Northrup (1926), Africa (1930), Shaw (1933), and Stunkard (1933) have each worked out certain phases of the morphology and life cycle of *Cercariaeum lintoni* at Woods Hole but without determining the adult. These larval stages were found by the author in *Ilyanassa obsoleta* Say, from San Francisco Bay, where this snail was introduced with the eastern oyster (Packard, 1918). The life history is as follows: The sporocyst stages are found in the digestive gland of *Ilyanassa,* from which tailless cercariae emerge and find their way into polychaete worms (*Capitella* sp., *Eteone* sp., *Streblospio* sp., and *Nereis* sp.). Shaw did not report finding infected annelids in nature. We find that cercariae penetrate these annelids and encyst as "mesocercariae" (Bosma, 1931). When these annelids, at least the smaller species, are eaten by crabs of the genus *Hemigrapsus,* the mesocercariae excyst, penetrate the gut wall and re-encyst on the outer surface of the pericardium and in the muscles as metacercariae. Metacercariae remain in the crab until eaten by the gull, *Larus californicus* Lawrence, the final host. The metacercariae excyst in the duodenum and adults are found attached about the opening of the caecae. The adult worm belongs to the genus *Levinseniella* Stiles and Hassall, and is therefore *L. lintoni* (Miller and Northrup). Experimental evidence proves the validity of this cycle. It is interesting to speculate that two metacercarial stages may be present in some other unsolved trematode life cycles.

27. *A Method for Transplanting Adult Trematodes.* PAUL BEAVER, University of Illinois and Oak Park Junior College.

Echinostoma revolutum may be taken from the intestine or cloaca of various species of birds or from mammals and transferred to pigeons by injecting them into the cloaca. Worms of all ages usually endure the process and live for periods equal to or greater than the expected normal life in the original host. The transplants are accomplished by taking worms from recently killed hosts, collecting them in a small quantity of warm water and introducing them directly into the cloaca of a pigeon by means of a pipette of suitable size.

28. *A Note on the Life History of* Mosesia chordeilesia *n. sp.* (*Lecithodendriidae*). DONALD B. MCMULLEN, Monmouth College.

Adults of *Mosesia chordeilesia* n. sp. are found in the intestine of certain insectivorous birds, particularly the nighthawk, *Chordeiles minor minor,* collected in northern Michigan. Body of the adult averages 1.087×0.635 mm., is covered with small spines except at the posterior end. Oral sucker larger, 0.078×0.058 mm., than acetabulum, 0.062 mm. in diameter. Pre-pharynx short. Esophagus relatively long. Pharynx at posterior border of oral sucker, 0.039 mm. in diameter. Intestinal ceca extend posteriorly and laterally to region of testes. Cirrus well developed. Genital pore surrounded by rosette of cells and is anterior and to left of acetabulum. Testes lateral, in third quarter of body and measure 0.246×0.168 mm. Ovary posterior and to right of acetabulum, 0.139 mm. in diameter. Seminal receptacle near ovary and median. Vitellaria compact, follicular and lie between intestinal ceca and the lateral margin. Coils of uterus contain 1–6 eggs in cross section, pass between testes and form a dense mass in posterior end. Eggs measure 0.029×0.016 mm. Excretory bladder V-shaped. Main excretory tubules attached at anterior tips of bladder. Near center of body they branch into anterior and posterior tubules. Mayfly nymphs, naturally infected with a Xiphidiocercaria, were fed to two canaries. The metacercariae are free in the body of the nymph. A stylet is present in the immature forms and tests are visible in the more mature metacercariae. Developmental stages of *Mosesia chordeilesia* were recovered from both experimental animals, including five-hour, two-day and five-day stages.

29. *A Study of the Endoparasitic Trematodes from Marine Fishes of Departure Bay, B. C.* SAMUEL HANFORD MCFARLANE, Aurora College.

Material for this research was collected at the Canadian Pacific Biological Station, Nanaimo, B. C. The fish from which the parasites were obtained were those that could be taken with a seine in shallow water. The mouth, gills, alimentary tract, and urinary bladder of one hundred fish were examined. The hosts represented nine different families: Syngnathidae, Pleuronectidae, Scorpaenidae, Hexagrammidae, Ophiodontidae, Scorpaenichthyidae, Cottidae, Embiotocidae, and Pholidae. The trematodes identified belong to fifteen different species, of which eight have been designed as new. They represent the following families: Bucephalidae, three species, all new; Allocreadiidae, four species, one new; Aporocotylidae, one species, previously described; Acanthocolpidae, two species, one new; Fellodistomidae, one species, new; Monorchidae, one species, previously described; Hemiuridae, three species, two new. As far as I know, this is the first definite attempt to make a survey of the trematodes of the marine fishes of the Pacific coast of North America. Additional materials were collected during the summer of 1934 and are now being studied.

30. *The Life History of* Cotylophoron cotylophorum, *A Trematode from Ruminants.* HARRY J. BENNET, Louisiana State University.

This trematode is widely distributed but has not been previously reported as an endemic parasite of American hosts. Average egg size 134 by 69 μ. The time required for the development of the miracidium, sporocyst, redia and cercaria is greatly influenced by temperature. Development of miracidium requires 11 to 29 days. Similar in structure to other amphistome miracidia. The arrangement of the ciliated epidermal plates in the order of 6; 8; 4; 2 is of possible taxonomic and phylogenetic value. Intermediate hosts are *Fossaria parva* and *F. modicella.* Miracidium retains epidermal plates during penetration. Each sporocyst produces a maximum of nine rediae. These are liberated at an average size of 0.188 by 0.056 mm. Each redia produces approximately 25 cercariae. The cercariae are born early, completing their development in the liver and ovotestis. Daughter rediae may or may not occur. Snails shed cercariae 30 to 91 days after infestation. Greatest number shed between 11:30 a. m. and 1:30 p. m. Metacercariae excyst in duodenum of final host and migrate to rumen after a minimum time of 21 days at an average size of 2.37 by 0.98 mm. They mature in about three and one-half months at an average size of 3 by 1.15 mm. The time required to complete the life cycle varies from about five to eight months.

31. *New Aspidogastrid Species, with a Consideration of the Systematic Position of the Group.* ERNEST CARROLL FAUST AND CHUNG-CHANG TANG, Tulane University and Fukien Science Institute.

New species of *Cotylaspis* and *Lophotaspis* have been obtained from *Amyda tuberculata,* Foochow, China, and a new species of *Stichocotyle* from *Rhinoptera quadriloba,* Biloxi, Mississippi. Aspidogastrid forms are in transition from ectoparasitism to endoparasitism, but there is no proof that they are digenetic. The larva hatched from the egg is essentially an immature adult and requires no true metamorphosis in its development. Because of these facts the group should either be returned to the Monogenea or placed in a separate subclass intermediate between the Monogenea and Digenea.

32. *The Larval Stages of Acanthocephala.* HARLEY J. VAN CLEAVE, University of Illinois.

At least two distinctive larval forms are generally recognized in the life history of the Acanthocephala but no distinctive names have ever been adopted. The name acanthor is here proposed to designate the first stage developing from the fertilized egg. Normally, the acanthor stage is liberated from the hard-shelled embryonic coverings when the shelled embryo is eaten by an arthropod host. The provisional boring spines of the acanthor by means of which the wall of the digestive tract of the host is perforated, have no direct connection with

the body spines or proboscis hooks of the mature worm. In the cavities and viscera of the arthropod host, the acanthor undergoes transformations during which the rudiments of proboscis, genital organs, and other structures which reach functional condition in the definitive host, are progressively differentiated. The name acanthella is here proposed for this series of stages extending between the acanthor and the fully formed worm ready to infest the final host.

33. *Characteristic Movements of the Miracidia and Cercariae of the Human Schistosomes of Egypt.* C. H. Barlow, Rockefeller Foundation and Public Health Laboratories, Cairo, Egypt.

On entering the snail hosts, *Planorbis boissyii* and *Bulinus contortus,* the miracidia of *Schistosoma mansoni* and *S. haematobium* do not shed their cilia. Once inside the lymph spaces they swim with almost the same freedom as they do in open water, coursing from one end of a lymph space to the other. In leaving one lymph space for another they penetrate the obstructing walls. Schistosome cercariae of both species do not swim for progress but to maintain position in the water only. They move up and sink down. If the water be agitated sharply and then allowed to stand it will be noted that most of the cercariae have congregated at the surface. The quick agitation of the water into which a workman must go to work, waiting a few minutes for congregation of cercariae at the surface, and then spraying the surface widely with a concentrated solution of Copper Sulphate kills most of the cercariae. Then the Copper Sulphate becomes diluted and entirely harmless.

34. *Three New Species of Larval Trematodes from Kentucky.* R. M. Cable, Berea College and Purdue University.

Three new species of cercariae have been found to occur in *Goniobasis semicarinata* from Scaffold Cane Creek, Madison County, Kentucky. *C. trichoderma,* a cotylicercous xiphidiocercaria, develops in oval sporocysts and is characterized by cuticular papillae, each of which bears a long, hair-like process. The esophagus ends a short distance behind the pharynx as a slightly expanded sac. The excretory formula is $2(2+3+3)$. The excretory vesicle is large and thick-walled. The glandular tail functions as a sucker. Encystment occurs in aquatic arthropods and in *Chaetogaster. C. ornatostoma* resembles echinostome cercariae but lacks the typical collar of spines and has a peculiar arrangement of spines in the oral area. The body is spinose and the acetabular opening is surrounded by a row of about forty blunt spines. The intestinal ceca extend to the bipartite excretory vesicle. The excretory trunks are filled with concretions. Gland-cells with rod-shaped granules are especially numerous in the lateral regions of the body where they form a pair of conspicuous, elongate, yellowish masses. *C. vogeli* is the first fresh-water lophocercaria to be reported from the United States. It is similar to the cercariae of *Cryptocotyle* and *Opisthorchis* in that it is binoculate and the tail is provided with a basal annulated membrane and a well-developed median fin-fold extending along its dorsal margin and around the tip for a considerable distance ventrally. The excretory vesicle is thick-walled and there are twelve penetration glands. Encystment occurs in fishes.

35. Parorchis avitus (*Linton, 1914*), *a Synonym of* P. acanthus (*Nicoll, 1906*). R. M. Cable and W. E. Martin, Purdue University.

Studies on mature adults and miracidia, obtained by feeding metacercariae to herring gulls, indicate that *Parorchis avitus* is not a valid species. Although Linton's observations of ovoviviparity and the presence of a redia in the miracidium have been confirmed, the number of free miracidia in the uterus is relatively small and the redia is inconspicuous. Constriction of the body is noticeable in both free-swimming and unhatched miracidia. The latter are extremely variable in shape and definite constrictions between adjacent rows of epidermal cells are observed in some cases. The ratio of sucker diameters in the adult is ap-

proximately 1:2 instead of 1:3 and the extent of uterine convolution varies. Descriptions of the cercaria disagree chiefly in regard to the gland cells and excretory system. These discrepancies are believed to be due to the difficulties encountered in observing the structure of the larval stages.

36. *The Finer Structure of the Body Wall and Parenchyma of Digenetic Trematodes.* THERON O. ODLAUG, New York University.

A study of three species of distomes, *Loxogenes arcanum, Pneumonoeces medioplexus,* and *Gorgoderina attenuata* has been made; and the structure of the body wall of each has been investigated. Of these species, only *Loxogenes arcanum* may be said to possess a true subcuticular layer of cells. In general, the cells of the parenchyma are of three types: (1), "subcuticular" cells arranged in groups and showing characteristic nuclear structure; (2), cells of a branched nature, which are scattered in the loose parenchyma; (3), cells of the connective tissue. The parenchymal lacunae of these forms have been studied, and the conclusion is reached that they are intercellular in nature. On a morphological basis, and limited to these three species, it may be postulated that there is no correlation between the physical structure of the cuticula and the environment of the parasite.

37. *A Restudy of Stafford's Types of the Trematode Genera* Lechriorchis *and* Zeugorchis. E. W. PRICE, U. S. Bureau of Animal Industry.

In 1905 (Zool. Anz., 28; 681–694), Stafford proposed the genera *Lechriorchis* and *Zeugorchis* for some trematodes of North American snakes. The descriptions of the types of these genera were brief and no illustrations were given, and as a result considerable confusion has arisen, especially with respect to the genus *Zeugorchis.* Recently the types of these genera were found in the U. S. National Museum collections and a restudy of this material has been made. This restudy revealed that the species at present included in the genus *Lechriorchis* have been rightly allocated, and that *Mediorima* Nicoll, as noted by Talbot (1934, Tr. Am. Mic. Soc., 53: 40–56), is congeneric with *Lechriorchis* Stafford. A comparison of *Zeugrochis aequatus* Stafford with *Caudorchis eurinus* Talbot revealed that these species are congeneric and *Caudorchis* must fall as a synonym of *Zeugorchis, C. eurinus* (= *Z. eurinus* apparently being specifically distinct from *Z. aequatus.* The species included by Talbot in the genus *Zeugorchis,* viz., *Z. bosci* (Cobbold), *Z. ancistrodontis* (MacCallum), *Z. syntometra* Sumwalt and *Z. megametricus* Talbot are not congeneric with *Z. aequatus* Stafford. *D. bosci* Cobbold appears to be more closely related to *Dasymetra* Nicoll than to any of the other related genera. The remaining species included by Talbot in the genus *Zeugorchis* apparently form a more or less homogenous group for which the new genus *Pseudorenifer* is here tentatively proposed, the diagnosis being that for Talbot's *Zeugorchis; P. megametricus* (Talbot) is selected as type, with *P. ancistrodontis* (MacCallum) and *P. syntometra* (Sumwalt) as included species.

38. *Two New Species of* Paralecithodendrium *from Bats.* RALPH W. MACY, College of St. Thomas.

Paralecithodendrium nokomis from the big brown bat, *Eptesicus fuscus,* and from the red bat, *Nycteris borealis;* and *Paralecithodendrium lucifugi* from the little brown bat, *Myotis lucifugus,* are described as new species.

39. *Some Tropical Fishes as Hosts for the Metacercaria of* Clinostomum marginatum. R. F. NIGRELLI, New York Aquarium and New York University.

The yellow grub stage of *Clinostomum* was found encysted on the following fishes received from Florida, British Guiana and South America: *Chriopeops goodei, Mollienisia velifera, Piabucana* sp., *Corynopoma riisci, Nannostomus trifasciatus, Lebistes reticulatus, Hypopomus artedi* and *Sternopygus macrurus.* In most instances the fishes showed no infection when they arrived, and only after they had been in the Aquarium for some time did the cysts appear. Whether the fishes were

originally infected or acquired the infection in the tanks is difficult to determine. Examination of snails and water of the Aquarium showed no forked-tail cercariae. In cases of severe infection the death of the host resulted. The trematodes were found encysted in the flesh and in the case of *C. riisci* the worm was embedded deep in the peculiar transparent muscle of the body. Observations on the "guppy," *Lebistes reticulatus,* showed that since this species is not influenced by seasonal changes, the cysts are not deserted as reported by Ward (1918) for Northern forms. Many species of temperate zone fishes present in the Aquarium have also shown yellow grub infection. In the majority of instances the metacercariae were found encysted on the fins. They appear in the spring, and in the winter the cysts are entirely absent. Examination of the parasites showed no difference, except for size, between the metacercariae found in the tropical forms and those of the temperate zone species.

40. *Experiments on the Control of* Epibdella melleni *MacCallum, a Monogenetic Trematode of Marine Fishes.* R. F. Nigrelli, New York Aquarium and New York University.

Epibdella melleni, a destructive fish parasite in the New York Aquarium is kept under control by increasing the specific gravity of the salt water. The lower density of bay water (1.010–1.0128) will also kill the parasites. Since most of the marine tropical fishes of the Aquarium are collected from around the Bahamas, the chemical condition of this water was simulated for aquarium use. The analysis of such water is as follows: free CO_2 p. p. m. – 0.0; CO_2 as bicarbonates mM – 2.0807; pH 8.3; sp. g. – 1.0265. However, this chemical condition proved to be very suitable for growth and reproduction of the parasites. It was found that the fishes most suceptible to infection were capable of living without any apparent discomfort in salt water with a higher density. Accordingly, the specific gravity of the entire system was increased with pure sodium chloride from 1.0284 to 1.037. The increased density with ordinary salt had little effect however on the eggs of the parasites. Previous experiments by R. L. Kuhn showed that rock salt was more effective and that prolonged exposure would cause a cessation in the development of the eggs. Due, however, to the presence of other substances, this salt was found to be detrimental to fishes and could not be employed. The higher specific gravity used in the present experiment was extremely effective in killing newly hatched larvae and the immature fixed parasites. After three months of such treatment, the entire system was free of eggs and parasites.

41. *On the Effect of Fish Mucus on* Epibdella melleni, *a Monogenetic Trematode of Marine Fishes.* R. F. Nigrelli, New York Aquarium and New York University.

Parasites were removed from infected fish, washed thoroughly in salt water and placed in petri dishes containing mucus from (1) immune grouper, (2) dogfish, (3) ray, (4) pompano, and (5) salt water (control). The dogfish and ray show a natural immunity and never become infected, whereas the pompano is very susceptible. The parasites in mucus from the dogfish were moribund in three hours, and in five hours practically all were dead. Those in mucus from the immune grouper were moribund in four hours and dead in eight hours. Most of the parasites in mucus from the ray were dead in four hours. Those in mucus from the pompano were alive from 18–24 hours, while those in sea water remained alive for three days. When kept in pompano mucus, washed several times, the worms survived for three days. Susceptible fish kept in tanks with elasmobranchs are never known to become infected. The experiments indicate that the mucus plays some part in the protection of these fish against the parasites.

42. *Studies on the Acquired Immunity of the Pompano,* Trachinotus carolinus, *to* Epibdella melleni. R. F. Nigrelli, New York Aquarium and New York University.

Periodic injections of serum from immune fish and with pulverized parasites were made to determine their effect upon the development of an immunity to

E. melleni in the very susceptible fish, *Trachinotus carolinus.* The experiments were conducted in successive eleven day periods. Fish A, at the end of each period yielded a total of 856 worms, 270, 169, 39, 15, 0. This individual passed through another severe epidemic without becoming infected. The fish is still alive. Corresponding figures for other specimens were fish B, 702, 290, 354 (died); fish C, 176, 85 (died); fish D, 245, 60, 114, 38, 0 (died from other causes at the end of six months); fish E, 234, 75, 58, 38, 0 (died from other causes at the end of four months); fish F, 298, 130 (died); fish G, 388, 48, 0 (died of other causes at the end of eight months); fish H, 28 (died); fish I, 35, 15, 3 (died). Fish A received periodic injections of serum from immunized pompano. Fishes B and C received injections of ground, dried and fresh worms, respectively. Fishes D, E, F, G, H, I were controls. The fish are capable of building up their own immunity and the effects of the injections do not appear to be significant. The results are indicative of some sort of skin immunity, such as reported by Nigrelli and Breder (1934).

43. *Studies on North American Gyrodactyloidea.* JUSTUS F. MUELLER, New York State College of Forestry.

The author is engaged in a comprehensive study of the small trematode gill parasites of freshwater fishes. To date about thirty species have been found, most of which are described and figured in an article shortly to appear in the Transactions of the American Microscopical Society. Further species are being added to this number by continued studies. On the basis of this work so far it is possible to state that the N. American gyrodactylid fauna is separate and distinct from that of Europe. To date only three European species have been recognized in collections from this continent, and these only on fish common to both continents (*Esox lucius,* trout, goldfish). It is further evident that most of the American forms are members of the *"Ancyrocephalus"* group. Only one native species of *Dactylogyrus* has so far been found. Hence the *"Ancyrocephalus"* group appears to be native of this continent; whereas, *Dactylogyrus,* judging from the number of European species described, and its scarcity in the American fauna, appears to be a European group. *Gyrodactylus,* however, appears to be a cosmopolitan genus. The genus *Ancyrocephalus,* sensu strictu, is marine. The freshwater forms which have been assigned to this genus exhibit such diversity of structure that many of them must be separated into new genera. The older designation *"Ancyrocephalus"* appears to be of subfamily, rather than generic value.

44. *The Course of Infection of* Trypanosoma duttoni *in Normal and in Splenectomized and Blockaded Mice.* WILLIAM H. TALIAFERRO and YELENA PAVLINOVA, University of Chicago.

The course of infection of *T. duttoni* in normal white mice approximates that of *T. lewisi* in white rats. There are, however, striking quantitative differences. Thus, reproductive activity is less during the first of the infection but continues at a minimal rate for several weeks in *T. duttoni* as compared with *T. lewisi.* Furthermore, there are ordinarily fewer trypanosomes throughout the infection of *T. duttoni.* The course of infection of *T. duttoni* in splenectomized and blockaded white mice (also in mice afflicted with intercurrent infection) closely resembles that of *T. lewisi* in *normal* rats. In comparison with normal infections in mice, both the reproductive activity of *T. duttoni* and the severity of the resulting infection are greatly enhanced. Although part of this difference is due to a lowering of acquired resistance (ablastin formation), it is largely due to a lowering of natural resistance of the mouse. This fact is of particular interest in showing that both natural and acquired resistance to the reproduction of the trypanosomes is dependent upon macrophage function.

45. *The Whole Life Cycle of* Strongyloides. ERNEST CARROLL FAUST, Tulane University.

Investigation during the past decade have provided important new data concerning the life cycle of *Strongyloides.* The fundamental, basic mode of develop-

ment is indirect. The direct type has been developed as a result of unfavorable environmental conditions, and the hyperinfective type as an adaptation to a purely parasitic life within the host. Under optimum conditions *Strongyloides* may be propagated exclusively as a free-living organism. Male worms of the parasitic generation exist, although they are ephemeral and do not commonly persist beyond the incubation period. They are "rhabditiform" in type, like the free-living stages of the genus, and do not invade the tissues. *Strongyloides* demonstrates how parasitism may be achieved.

46. Ornithodorus hermsi *Wheeler as a Vector of Relapsing Fever in California.* W. B. Herms and C. M. Wheeler, University of California.

This new species of tick is found at elevations ranging from about 5,000 to 8,000 feet in California and is commonly found in the nests of chipmunks, proven reservoirs of the spirochaete of relapsing fever. Ticks taken in nature in cottages where cases have occurred when allowed to bite white mice transmitted the spirochaetes. Transmission is effected by the bite of both female and male ticks and in all instars, spirochaetes being observed in the blood of white mice usually about 5 days after the infective bite. A small percentage, probably less than fifteen percent of the offspring of infective females are able to transmit the disease, thus proving hereditary transmission. When clean ticks are fed on experimentally inoculated mice, the percentage of ticks becoming infective appears to be about thirty percent, based on rather meagre experimental data. *Ornithodorus hermsi* deposits well over 200 eggs in a given season, from May to October. The incubation period ranges from 15 to 21 days at a temperature of 75° F. and humidity at about 90%. The time required for the several instars depends on the opportunity to feed. After each feeding, requiring about 15 minutes, occasionally as long as 30 minutes, there is a molt, maturity being reached after the fifth including the first which is effected before hatching. The cycle from egg to egg under optimum conditions requires about four months.

47. *Complement Fixation Tests on Monkeys Infected with* Endamoeba histolytica. William W. Frye and Henry E. Meleney, Vanderbilt University.

48. *Some Unsolved Problems in the Parasitology of Amebiasis.* Col. C. F. Craig, Tulane University.

President's address.

49. *Some Blood Parasites from Eastern Nebraska Vertebrates.* G. Robert Coatney, Peru State Teachers' College, Nebraska.

During the past year a survey of blood parasites has been carried out with special emphasis on the protozoa. To date 96 vertebrates have been examined including 75 birds, belonging to 32 different species, 7 mammals representing 5 different species and 14 reptiles of 7 different species. *Haemoproteus* parasites were found in 6 species of birds. Five of these are new host-records and at least one is believed to be new. Trypanosomes were found in one mammal (first North American record for this species), one reptile, a new species and two species of birds. The latter are new host-records and probably new species. Three different species of birds harbored *Leucocytozoa* and at least two are considered as new. *Plasmodia,* as yet undetermined, were found in three bird species. Two species of reptiles were positive for Haemogregarines. Two, and maybe three, species of Microfilarie were encountered in 3 species of birds.

50. *Filarial Parasites of the Monkeys of Panama.* O. R. McCoy, University of Rochester.

Seven different kinds of microfilariae were found in the blood of the eight species of monkeys which occur in Panama, 85 per cent of 72 wild monkeys examined being infected with one or more species of microfilariae. *Acanthocheilonema gracile* was the parasite most frequently encountered, the adult worms being located in the peritoneal and pleural cavities, and occasionally within the pericardium.

The microfilaria of this species possessed a sheath; all other microfilariae were unsheathed. The adult forms of two new species belonging in the genus *Tetrapetalonema* Faust (1935) were found in the connective tissue and under the fascia of the muscles of the back. One of these was found in the white-throated monkey, *Cebus capucinus,* the other in the red and black spider monkeys, *Ateles geoffrayi* and *A. dariensis.* The adult forms of three types of microfiliariae were not found.

51. *Effect of Parathyroid Extract (Lilly) and Calcium Lactate on Trichinized White Rabbits.* Wayne W. Wantland, Northwestern University.

Each of ten white rabbits was infected with approximately 5,000 *Trichinella spiralis.* Six of these animals were given parathyroid extract subcutaneously and calcium lactate per os. The remaining four animals were controls. Trichinized white rabbits treated with 1 to 2 c.c. of parathyroid extract and 4 to 5 gm. of calcium lactate every other day beginning the sixty-eighth day after infection, showed no calcification of cysts one hundred and two days after infection. Trichinized white rabbits treated with 1 to 2 c.c. of parathyroid extract and 2 to 4 gm. of calcium lactate every other day beginning the fifth day after infection showed no calcification of cysts thirty-two days after infection. The state of encystment in the treated animals differed in no respect from that which occurs normally (without treatment) in rabbits at corresponding periods after infection. Increased amounts of parathyroid extract (1.5 to 2 c.c. per day) and calcium lactate (4 to 5 gm. per day) for sixteen days, treatment beginning on the sixth day after infection, failed to hasten encapsulation of trichinae larvae and promote calcification of cysts in the white rabbit. The administration of parathyroid extract (subcutaneously) in all cases studied produced a definite hypercalcemia but in no case did it result in accelerated calcification of trichinae cysts as is found in infected white rabbits following oral administration of irradiated ergosterol and calcium lactate.

52. Cercaria kentuckiensis, *n. sp., First Representative of the "Vivax" Group Known to Occur in the United States.* R. M. Cable, Berea College and Purdue University.

Cercaria kentuckiensis is a longifurcous, pharyngeate cercaria, developing in simple, elongate sporocysts in *Goniobasis semicarinata* from Madison County Kentucky. The body is pyriform, flattened, and measures 0.274 mm. long by 0.14 mm. wide in living specimens under light pressure. The tail it attached dorsally; the tail-stem is 0.39 mm. long by 0.04 mm. wide. The furcae are 0.335 mm. long and the dorsal and ventral margins of each are provided with a fin-fold which is continuous around the tip. The body and furcae are spinose; the tail-stem is provided with delicate hair-like processes which are more numerous distally. The acetabulum is only partially developed. The protrusible penetration organ is 0.048 mm. wide and contains numerous gland-cells. Other glandular cells occur in the anterior region of the body. The esophagus is short and the prominent, tortuous ceca extend to the level of the excretory vesicle. The excretory formula is $2[(14)+3]$. The vesicle is transversely elongate and receives two median and two lateral ascending trunks. The median trunks fuse anterior to the acetabulum and again separate before joining the lateral trunks at the level of intestinal bifurcation. The excretory pore is dorsal at the base of the tail and an Island of Cort is present. The caudal excretory tubule bifurcates and its branches extend to the tips of the furcae. The genital primordium is prominent and lies anterior to the bladder and between the median excretory trunks.

53. *Acanthocephala of the Burbot "Eel,"* Lota vulgaris. Helen L. Ward, Purdue University.

Three species of acanthocephala, belonging to the genus *Echinorhynchus,* have been found to parasitize the burbot eel from the Great Lakes Region. The specific characters of these acanthocephala will be demonstrated.

54. *The Study of Metacercariae as an Approach to Life History Problems.* Sewell H. Hopkins, A. and M. College of Texas.

The author believes that the study of the metacercaria should be the first step, whenever feasible, in the solution of a life history problem in the Trematoda. The metacercaria usually shows enough of the adult characteristics to make identification possible, at least to genus, while still retaining such features of the cercaria as the excretory system (which can be seen better in the metacercaria than in any other stage), cephalic glands, and sometimes stylet and eyespots. A survey of metacercaria in freshwater invertebrates, now in progress, has already revealed the following identifiable forms: *Gorgodera* sp., clearly showing the nine testes, in crayfish, Louisiana; *Gorgoderina* sp. in freshwater shrimps, Texas; *Lecithodendrium* sp. in mayfly nymphs, Illinois; *Polylekithum ictaluri* (Pearse) in Unionidae and Sphaeriidae, Illinois and Mississippi; *Anallocreadium armatum* (MacCallum) in Unionidae, Michigan; *Allocreadium* sp. in Unionidae, Texas. The excretory system of *P. ictaluri* and of the *Allocreadium* from Texas have been worked out in detail.

55. *Further Occurrence of Lymph Vessels in Distomes.* H. W. Manter, University of Nebraska.

The trematode genera *Megasolena* Linton and *Hapladena* Linton have been shown recently by the writer to possess lymph vessels and other amphistome-like features forcing their removal from the Allocreadiidae. Two undescribed species of allocreadid-like distomes from marine fishes of the tropical Pacific are found to possess conspicuous lymph vessels. But these trematodes are not closely related to *Megasolena* or to *Hapladena.* The body is very flat and thin, copulatory organs are lacking, the lymph vessels are branched posteriorly and the excretory vesicle is unforked. Were it not for the lymph vessels these forms would be classified with such Allocreadiidae as *Homalometron* and *Anallocreadium* which lack a cirrus sac. These new trematodes suggest a connection between amphistomes and Allocreadiidae and that Allocreadiidae especially of marine fishes should be examined for the presence of lymph vessels. Circular muscles in the anterior part of the pharynx are probably of considerable taxonomic significance.

56. Polystoma integerrimum nearcticum *n. subsp. from the Urinary Bladder, Genital Ducts, Kidneys and Gills of* Hyla versicolor *Le Conte.* Allard A. Paul, New York University.

Five species of polystomes have been reported from Amphibia: *Polystoma integerrimum* Frölich, 1791 (from Europe and Japan), *P. bulliense* Johnston, 1913 (from Australia), *P. alluaudi* Beauchamp, 1913 (from Africa), *P. africanum* Szidat, 1931 (also from Africa), and, recently, *Diplorchis ranae* Ozaki, 1935 (from Japan). The present form is the first reported from Amphibia in America. From the bladders of 243 mature toads (*Hyla versicolor* Le Conte) collected from June 1 to June 9, 1935, 304 worms were obtained. Eggs of these specimens were allowed to hatch in aquaria with laboratory-raised tadpoles of *H. versicolor,* and all stages of the developing larvae, culminating in a sexually mature gill form, were obtained. Later, larvae from eggs of this form were secured, as well as various stages of their development in the urinary bladder, genital ducts, and kidneys. The life history of *P. integerrimum* of Europe has been described recently by Gallien, and the life history of the new form described above has been found to parallel, in general, that of *P. integerrimum.*

57. *Ants as Intermediate Hosts for Two Species of* Raillietina *Parasitic in Chickens.* Myrna F. Jones and Margery W. Horsfall, U. S. Bureau of Animal Industry.

Two species of ants, *Tetramorium caespitum* and *Pheidole* sp. (identified by Dr. W. M. Mann, Smithsonian Institution), which were collected in a poultry yard at the Beltsville Research Center, Beltsville, Maryland, during the summer and fall of 1935, contained 2 types of cysticercoids. Chickens in this yard were naturally infested with *Raillietina echinobothrida* and *R. tetragona.* Specimens

of *R. echinobothrida* and *R. tetragona* were recovered from laboratory-reared chickens approximately 3 weeks after cysticercoids from infested ants were fed to them; control birds remained negative. Sixteen worms were recovered from 3 of 7 birds fed a total of 38 *R. echinobothrida cysticercoids;* one adult worm was recovered from a chicken fed 2 cysts of *R. tetragona.* Cysticercoids of the 2 species, although generally similar, differed as follows regarding size and rostellar hooks: *R. echinobothrida,* maximum size (living specimens) 348 μ by 250 μ, minimum size 306 μ by 161 μ, typically about 350 μ by 250 μ; approximately 200 rostellar hooks 10 μ and 13 μ long arranged in 2 rows. *R. tetragona,* 2 living specimens, 306 μ by 161 μ and 290 μ by 177 μ, with about 100 rostellar hooks, approximately 6 μ long, arranged in 1 row. Of 1007 specimens of *T. caespitum,* 26 contained a total of 56 cysticercoids of *R. echinobothrida,* 1 contained 1 cysticercoid of *R. tetragona.* Of 238 specimens of *Pheidole* species, 7 contained 10 cysticercoids of *R. echinobothrida,* one contained 2 cysticercoids of *R. tetragona.*

58. *On the* Diphyllobothrium *of Yellowstone Park.* JOHN W. SCOTT, University of Wyoming.

The plerocercoids are found in *Salmo lewisi, S. irideus,* and *Thymallus montanus.* The plerocercoids located among the viscera, are of three, possibly four types; one type, after attaining a length of 3–8 cm. may migrate into the flesh. All types may be distinguished from plerocercoids of *D. latum,* by color, size and robustness of form. The adult tapeworms are found in black and grizzly bears, white pelicans, California gulls, and American mergansers. *Diphyllobothrium cordiceps* is found in pelicans, gulls, and both species of bears; however, it is less thrifty and not so large in gulls and in bears is probably always sterile, resulting in a long attenuated worm of several hundred segments. The other adult *Diphyllobothrium* of bears show astonishing variations in size, length, shape and size of scolex, number of proglottides, number of testes, position of genital pore, uterine loops, levels at which the genital anlage and the eggs appear, and ratio of length to width of proglottides. With this wide variation there is some justification for referring individual worms to *D. latum* (Skinker '31 '32) or to *D. cordatum* (Scott '32). However, Woodbury ('35) has shown that man is not infected by swallowing either large or small plerocercoids, and a study of material suggests that we have here a highly variable species with several sub-species, or possibly three closely related species, between which hybridization may occur, all different from *D. latum* or *D. cordatum.* Feeding experiments with dogs, cats, pelicans, and gulls support this view.

59. *Human Infestation with the Dwarf Tapeworm,* Hymenolepis nana, *in Southern United States.* G. F. OTTO, Johns Hopkins University.

Human infestation with the dwarf tapeworm ranged from 0–9.3 per cent in South Eastern United States. Outside the mountain areas the incidence averaged a fraction of a per cent. In the rural mountain population it was between 3 and 4 per cent. In the mining camps in the Kentucky Mountains it was between 9 and 10 per cent. The greatest infestation was in the 5–14 year age group (3.5 to 4.5 per cent in the rural mountain population). In all other age groups in the same area the incidence was less than two per cent. In adults (over 20 years) and children less than 2 years the incidence is only a fraction of a per cent. Since the highest infestation is in the same area and age group with the highest ascaris infestation it suggests a similarity in acquisition of these infestations. The protozoa incidence is also exceptionally high in this area and the high incidence first appears in the same age group with the high ascaris and dwarf tapeworm infestation. It seems unnecessary then to invoke the rat as a disseminator of the infection. The fact that the incidence with the dwarf tapeworm is so much lower than that of the other infestations mentioned may be attributed to the fact that the tapeworm eggs are less resistant to environmental conditions.

Human infestation is probably for the most part acquired from contamination with fresh feces of human carriers.

60. *Epidemiologic Determinations Concerning* Moniezia expansa *in sheep.* NORMAN R. STOLL, Rockefeller Institute, Princeton, N. J.

A presentation of certain facts which seem of promise in bringing this unarmed tapeworm under control, as well as aiding in the elucidation of its life history.

61. *Six Years' Intensive Observation of the Seasonal Prevalence of a Tick Population in Western Montana.* C. B. PHILIP, Rocky Mountain Laboratory, U. S. Public Health Service.

Quantitative samples of an adult tick population (*Dermacentor andersoni*) on the vegetation of a surveyed 40-acre tract in the Bitterroot Valley, were made by a method of dragging described elsewhere, approximately bi-weekly or weekly, according to conditions, through the "tick-season" of 1930 and the 5 subsequent seasons. Repeated samples were taken over exactly the same straight lines of travel without regard to contour, game trails, changes in vegetational cover or moderate inclemencies of weather, each sample yielding an estimate of 1 per cent of active ticks on the area for the day, based on percentage of area covered. Ticks were liberated as soon as taken. Records included weather conditions, elapsed and total time by stop watch, sex-ratio counts, and observed animal hosts or sign. Ticks caught early in the season were touched dorsally with a drop of paint, a different color for each season and by this means were found to persist through at least 2 seasons in the unfed condition although tremendously depleted in numbers through various natural causes by the second season. Males predominated in the early samples. Peaks of abundance occurred about the middle of April and the beginning of hot weather in June resulted in rapid depletion of numbers so that by early July few or no ticks were taken on the crossings. Neither rain nor night-fall caused them to leave the vegetation, but moderate concentration on game trails and some migration in direction of animal or human "paraphernalia" was demonstrated.

62. *The Western Dog Tick,* Dermacentor occidentalis *Neum., a Vector of Bovine Anaplasmosis in California.* W. B. HERMS and D. E. HOWELL, University of California.

Dermacentor occidentalis is a widely distributed and abundant tick in California. It has a wide host range and is commonly found in all stages except larvae (which may readily be missed on inspection) on cattle and deer, the latter a potent reservoir of anaplasmosis. Experimentally the larvae of this species feed well on cattle. Anaplasmosis was first definitely diagnosed in California in 1925, and deer were proved to be carriers in 1933. One non-hereditary transmission was effected by means of *Dermacentor andersoni,* but because of its narrower distribution work with this species was temporarily discontinued and attention was given to the western dog tick. Two positive cases are here reported, both hereditary transmissions. Case No. 1. Adult ticks collected in nature, fed May 28 to June 1, 1935, on a case infected by *Dermacentor andersoni* which had previously fed on a cow experimentally infected with blood from a deer carrier. Numerous larvae hatching July 29–August 4 were placed on the scrotal sac of a young bull August 19, 1935, and removed August 23, with first marginal bodies observed September 25, an elapsed period of 37 days since application of the ticks. Case No. 2. Adult ticks taken (in nature) from a diseased cow laid eggs February 1 to 15, 1935. Larvae numbering 2000–3000 placed on udder of healthy cow March 7, 1935, removed March 21, 1935. First marginal bodies appeared July 8 and the animal died of anaplasmosis July 18, 1935. Elapsed time between first larval tick bites and appearance of marginal bodies in this case was 153 days.

63. *A Study of the Anoplocephaline Cestodes of North American Rabbits.* JOHN G. ARNOLD, JR., New York University and Loyola University.

This investigation was undertaken to give additional information, correct the errors, and eliminate the confusion that has existed in the knowledge of the rabbit cestodes of the family Anoplocephalidae. The cestodes studied were obtained either from a routine examination of one hundred and seventy-nine North American rabbits or borrowed from various sources. The cestodes of the North American rabbits were contrasted with a large collection from European rabbits. The results showed that there were two genera of the family Anoplocephalidae found in North American rabbits, namely, *Schizotaenia* and *Cittotaenia*. There were two genera of the same family found in European rabbits. They were *Andrya* and *Cittotaenia*. The species of the various genera were compared in detail.

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William A. Riley	1925–26; 1928–30	H. E. Ewing	1931–1932
Charles W. Stiles	1925; 1929–32	Ernest Carroll Faust	1931–1934
E. E. Tyzzer	1925–1926	John F. Kessel	1932–
Maurice C. Hall	1926–1929	D. H. Wenrich	1932–
W. G. Smillie	1926–1927	H. E. Meleney	1933–
Henry B. Ward	1926–1929	Norman R. Stoll	1933–
Franklin D. Barker	1927–1930	Eloise B. Cram	1934–
J. H. St. John	1927–1928	Wilbur A. Sawyer	1934–
W. H. Taliaferro	1928–1931		

* Deceased.

LIST OF MEETING PLACES

1925	Kansas City	1930	Cleveland
1926	Philadelphia	1931	New Orleans
1927	Nashville	1932	Atlantic City
1928	New York	1933	Boston
1929	Des Moines	1934	Pittsburgh

IN MEMORIAM

Clifford H. Alvey (1908–1935)

Clifford Harry Alvey, Assistant Professor of Zoology in Purdue University, died in Lafayette, Indiana, 10 September, 1935. He was born at Cavour, South Dakota, 12 July, 1908. In 1928 he received the Bachelor of Science degree from Huron College. His graduate work was done at New York University where he became Master of Science in 1930 and Doctor of Philosophy in 1933. At New York he was a graduate assistant in Biology. In 1934 he was appointed instructor in zoology at Purdue University and at the end of one year advanced to the rank of assistant professor. He was a member of Sigma Xi, the American Society of Parasitologists, the American Society of Zoologists, the American Microscopical Society, and the American Association for the Advancement of Science. He had published results of investigations in cytology, protozoology and helminthology. His chief interest, however, was in the parasitic worms, and his thesis was done on the biology and development of Sphyranura. Endowed with an excellent mind and a charming personality, he was on the threshold of a brilliant career as teacher and investigator. In his untimely death the scientific world has suffered a sad loss.

RESEARCH NOTES

EIMERIA MESERVEI A NEW SPECIES OF COCCIDIA FROM FORSTER'S TERN, *STERNA FORSTERI* NUTTALL

The examination of the intestinal contents of four terns, *Sterna forsteri* Nuttall, at the Iowa Lakeside Laboratory, during the summer of 1935, revealed an undescribed species of Coccidia belonging to the genus *Eimeria.* Many of the oocysts were spherical although some were subspherical and measured 16.2 μ to 19.4 μ in length and 14.5 μ to 18 μ in width. The average size, of twenty-five specimens, was 17.74 μ by 16.76 μ. When placed in potassium dichromate solution, at laboratory temperature, the cytoplasmic mass completed the sporulation process in twenty-four hours with the production of four sporocysts, each with an elongated residual mass, and a large oocystic residual mass, which in some

EXPLANATION OF FIGURES

×2120

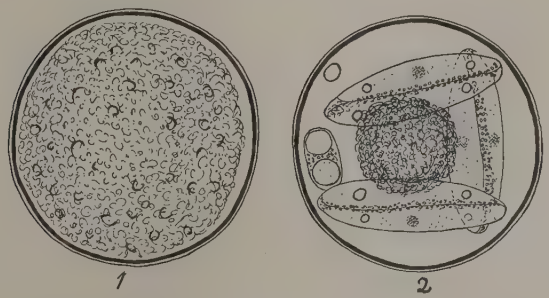

FIG. 1. Unsporulated oocyst of *Eimeria meservei* n. sp.
FIG. 2. Sporulated oocyst of *Eimeria meservei* n. sp.

cases measured up to 9 μ in diameter. This large residual body soon began to degenerate, and after 8 to 10 days about all that remained was a large vacuole housing a small mass of granular material. There is a distinct micropyle. The name *Eimeria meservei* is proposed for this species, in honor of Dr. F. G. Meserve, now of Sioux Falls College, who contributed so much to the writer's early training in zoology.

Another coccidium, decidedly ellipsoidal in shape and measuring 27 μ by 18 μ, was also encountered but could not be obtained in sufficient numbers for study.—G. ROBERT COATNEY, *State Teachers College, Peru, Nebraska, and Iowa Lakeside Laboratory, Milford, Iowa.*

SURVEY OF INTESTINAL PROTOZOA AT AUTOPSY

Determination of the incidence of protozoan infections in temperate climates has been the object of a large number of surveys in the past few years. The autopsy study here reported has been carried out with the intention of noting the degree of correspondence of this incidence with that found in cadavers coming from a comparable living population. The cadavers examined represent a series of one hundred cases, selected without reference to age, sex, color, or cause of death. The cases were for the most part children 7 years or less (28%), and middle-aged adults 30–60 years (42%). The principal causes of death were

malignancy (16%), and cardiac, circulatory and pulmonary diseases (51%). Autopsy revealed a colonic hypermia or hemorrhage in 11% of the cases and colonic ulceration in 6%. The time between death and examination varied. In 87% of the cases, however, the autopsy was performed within 24 hours after death; 29% were autopsied within 6 hours after death. Fecal material was obtained from the colon and, in the majority of cases, examined immediately in a water suspension under a cover-slip, using low-power oculars and the 16 mm. and 4 mm. objectives. In all instances of doubt, the specimen was also examined in an iodine solution under a cover-slip. In 21% of the cases, the material was taken at night and refrigerated, being examined the next morning.

In this series of 100 cases, only one positive specimen was found, showing a heavy infection with *Giardia lamblia* cysts. The case was that of a twelve-year-old white boy who was hit by an automobile in a sled accident, receiving a fractured skull. He died in less than 24 hours after being admitted to the hospital. The autopsy was performed within two hours after death and the material examined immediately. In view of the reported incidence of intestinal protozoa in a comparable living population, this seems a rather curious result. In a survey for protozoa among living adults of this city (Baltimore), Andrews and Paulson (1931) report positive specimens in 11.2% of their cases. This result compares favorably with a previous survey of a similar series (Paulson and Andrews, 1927), in which 10.5% were positive. The cases included in these two series are described as applying for hospital dispensary care and hence coming from the least sanitary sections of the city. In most details of living conditions as regards climate, food, and sanitation these individuals should be closely comparable with those in this autopsy series. More juveniles were undoubtedly included in the latter than in the former. Nevertheless there is a significant disparity between the protozoan incidences found for the two groups. Judging by reports on living material, at least 10% of the cases might have been expected to be positive. It therefore seems probable that human intestinal protozoa do not remain in a recognizable state many hours after the death of the host. This experience seems to direct attention to the fact that protozoological observations upon post-mortem material should be made as soon after death as possible.—GRACE KERBY, *Department of Pathology and Bacteriology, Medical School, and Department of Protozoology, School of Hygiene and Public Health, Johns Hopkins University, Baltimore, Md.*

THE TAIL STRUCTURE OF THE INFECTIVE *STRONGYLOIDES* LARVAE

Literature in parasitology points out that the tip of the tail of the infective (filariform) larvae of *Strongyloides* is forked or bipartite. In recent observations, the writer has noted that in *Strongyloides papillosus* of sheep and *S. ransomi* of swine, the tip of the tail of filariform larvae is tripartite (Fig. 1), 2 of

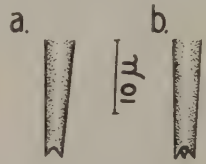

FIG. 1. Tip of tail of *Strongyloides papillosus;* (a) lateral view; (b) ventral view.

the minute projections seen on the tip of the tail being subventral and 1 dorsal. When the larva is viewed laterally, the dorsal and one of the subventral projections are usually noted. There is a possibility that the tails of filariform larvae

of other members of this genus also are of the same character.—Joseph E. Alicata, *Zoological Division, Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C.*

EXPERIMENTAL LESIONS CAUSED BY *TRICHOMONAS COLUMBAE* IN THE CHICKEN

Cauthen (in press) was the first to demonstrate that *Trichomonas columbae* (Rivolta, 1880) can be established in the crop of chickens when they are on a suitable diet, but without producing lesions. Tissue lesions have been produced experimentally in pigeons (Bos, Zentralbl. Bakt. Parasit. u. Infektionskr., Abt. I., Orig., 130: 220–227, 1933; Cauthen, Proc. Helm. Soc. Washington, 1: 22, 1934), mice (Bos, Zentralbl. Bakt. Parasit. u. Infektionskr., Abt. I., Orig., 132: 453–458, 1934) and in turkeys (Bos, Tijdschr. v. Diergeneesk., 61: 1125–1139, 1934).

In the experiments reported here 0.5 cubic centimeter of a 4-day-old bacteria-free culture of *T. columbae* was injected into the breast muscles of a pigeon and four chickens of 45 grams weight. Five days later the animals were killed and the sites of inoculation searched for lesions and trichomonads. The pigeon showed a typical necrotic abscess with yellowish pus and very many flagellates. Three chickens did not have any lesions. The other had a small abscess very similar to that of the pigeon and its pus was rich in trichomonads. Four young rats of 58 to 70 grams weight that were inoculated with the same amount of the same culture in the muscles of the hind legs did not show any lesions when killed.

In conclusion, the experiments reported here show that *T. columbae* is able to produce pathologic lesions when inoculated into the breast muscles of chickens. —Arnoldo Gabaldon and Justin Andrews, *Johns Hopkins School of Hygiene and Public Health.*

A NOTE ON A FAECES SURVEY IN A RURAL GREEK POPULATION OF A PELOPONNESIAN VILLAGE

During the period of inter-regnum between two blackwater fever seasons a limited survey was made of the parasite content of the faeces of the inhabitants of a village on the southern shores of the Gulf of Corinth in the Peloponnesus. In all 200 specimens of faeces were examined. Two smears were made from each, one in normal saline, and the other in a solution of iodine in potassium iodide. The whole field under a 5 x 3 cm. cover slip was searched with the low power; anything suspicious was examined further by the high and dry, or the oil immersion. Concentration of the faeces by the method of Clayton Lane failed to reveal any hookworm eggs. The total parasite rate for the whole village was found to be 72%. The infection rate among the males and females was not significantly different, being 76% among the females, and 68% among the males.

Below are summarized the findings for the various parasites:

E. histolytica (cysts)	10%
E. coli (cysts)	13%
Lamblia (cysts)	8%
Iodamoeba (cysts)	6%
Ascarids (eggs)	29%
Trichurids (eggs)	42%
Taenias (eggs)	2%
Trematodes (eggs)	5%
Enterobius (eggs)	1%
Hymenolepis (eggs)	3%
Dipylidium (eggs)	1%
Non-classified	12%

In the various age groups the infestation was distributed as follows:

Age group	Males	Females
1 to 5 yrs.	66%	66%
6 " 10 "	80%	92%
11 " 14 "	66%	77%
15 + ...	64%	66%

Among those carrying parasites in their faeces there occurred the following distribution: double infections, 37%; triple infections, 12%; quadruple infections, 3%; quintuple infections, 1%. The village had a spleen rate of 50% (Malaria) in 1933: kala-azar was prevalent, but the rate of infection was not known.—HENRY FOY AND ATHENA KONDI, *League of Nations Blackwater Fever Laboratory, Salonika, Greece,*

CULTURAL AND MICROSCOPIC DIAGNOSIS OF *TRICHOMONAS FOETUS* INFECTION IN CATTLE

The object of these observations was to determine the comparative efficiency of cultural and microscopic diagnosis of *Trichomonas foetus* from vaginal washings of heifers. The culture method used was the Locke-egg-blood medium of Kofoid and Wagener (1925, Univ. of Calif. Pub. in Zool., 28: 127) recommended for the cultivation of this organism by Gehring and Murray (1933, Cornell. Vet. 23, 335) and Glaser and Coria (1935, Am. Jl. Hyg., 22: 221–226). Certain heifers from the herd maintained by the U. S. Department of Agriculture Bureau of Dairy Industry at Beltsville, Maryland, were examined each week by introducing a speculum into the vagina, washing the walls with the fluid part of the culture medium, returning the aspirated washings to the egg slant, and by immediately examining under the microscope the material adhering to the speculum after it was withdrawn. The cultures were examined the following day, it having been determined that more positive cultures were found on the first day after implantation than on subsequent days. On several occasions, the culture medium was enriched by the addition of one part of bovine serum to nine parts of the Locke-blood mixture which overlay the egg slants. The results are shown as follows:

Medium used	Total Number of examinations	Positive by culture and by direct microscopy	Additional positive		
			By culture only	By direct microscopy only	Total Positive
Locke-egg-blood	283	20	7	8	35
Locke-egg-blood-serum ..	128	12	10	5	27

These data show that neither of these cultivation methods nor direct microscopical examination shows all the positive cases, and it is doubtful if the combination could be depended upon to reveal all positive cases. While the trend of these figures indicates the advisability of using both cultural and direct microscopical techniques, statistical analysis shows that, in the long run, the combination could not be depended upon to yield a significantly higher incidence of positives than either single method. The Locke-egg-blood-serum mixture appeared to be more efficient in detecting infections than did the Locke-egg-blood medium. JUSTIN ANDREWS, KATHEL B. KERR, AND DALE A. PORTER, *Johns Hopkins School of Hygiene and Public Health.*

MEROZOITE INFECTION IN COCCIDIOSIS

Andrews (1927, Jour. Parasit., 13: 183–194) reported his success in transmitting *Isospora felis* to cats, by intraduodenal injections of merozoites in warm saline, but found it impossible to transmit *Eimeria perforans* or *E. stiedae* to cats. The source of the merozoites of *Isospora felis* was indicated, but the length of time the host source had been infected and the developmental type of merozoites present was not. Neither was the absence of sporozoites assured. Since the experimental cat eliminated oocysts on the fifth day, and since the prepatent period of *I. felis* may coincide with this figure, the infection might have been accomplished by sporozoites present and not by merozoites. Tyzzer's (1929, Amer. Jour. Hyg., 10: 269–283) attempts to infect chickens by rectal injections of merozoites of *Eimeria tenella* all resulted negatively. From the results of these works it would appear that all attempts to transmit an *Eimeria* by means of its asexual phases have proved negative, and although a successful transmission of *I. felis* has been reported, the infection may actually have been accomplished by sporozoites present.

The following experiment shows that the merozoites of at least one species of *Eimeria* are infective under certain conditions. A young rat was infected with oocysts of *E. miyairii* and the infection allowed to progress for 5 days. This period was chosen because at that time, in a series of experimental rats no sporozoites were ever found in the intestine nor had any cysts developed—the prepatent period being 7 days. On the fifth day the rat was killed and a suspension of merozoites made in warm saline. This suspension was forced into the stomach of a previously uninfected rat (starved for 18 hours) by means of a stomach tube. Oocysts appeared in the feces of this rat two days later, thus showing that the asexual transmission of *E. miyairii* is possible.

Since there has been much discussion about the limitations of life cycles of coccidia, it may be well to note here that if the cycle of *E. miyairii* is limited by its host to a prepatent period of seven days, the time elapsed before oocysts were eliminated from the second rat mentioned above should have been equal to the prepatent period. But since the total time spent in endogenous development in both rats is equal to the prepatent period in a single rat it is shown that this species, at least, has a self-limited life cycle. The lapse of 5 days between infection and oocyst elimination as gotten by Andrews may be interpreted as being the time necessary for the host to cause cyst formation. But this and the other interpretation made are only problematic since the data are not complete enough to show definitely the exact condition of infection. If, however, this is true there is a difference in the cycles of the *Eimeria* studied by us and the *Isospora* studied by Andrews.

Andrews (1927, *l. c.*) showed that animals normally immune to infection by oocysts of certain species of coccidia could not be infected by the merozoites of those species. In order to ascertain whether an animal, normally susceptible to the oocysts of a species, could be infected with merozoites of that species during the period of immunity, the following experiment was conducted. Two rats were fed an immunizing dose (Becker, 1934, Coccidia and Coccidiosis of Domesticated, Game and Laboratory Animals and of Man, Ames, Iowa) of *E. miyairii* oocysts. Ten days later in order to be absolutely certain that they were immune a dose twice the size of the initial dose was given. Examination 7–10 days later proved them to be immune. Merozoites were given to these animals exactly as described above, but salt flotations made from 7–10 days failed to show any signs of infection.

Thus it is shown that the merozoites of *E. miyairii* may infect a non-immune rat but the immunity acquired by feeding oocysts is sufficient to prevent an infection by the asexual phases of the same species.

The author is indebted to Dr. E. R. Becker, of Iowa State College, for criticism and suggestions concerning the preparation of this manuscript.—

ROBERT L. ROUDABUSH, *Department of Zoology and Entomology, Iowa State College.*

BALANTIDIUM COLI: EFFECTS OF INCREASING THE VISCOSITY AND CRYSTALLOID CONTENTS OF THE INTESTINE OF AN EXPERMENTAL HOST ON THE DENSITY OF THE INFECTION

That diet plays a rôle in the numerical population of protozoa that parasitize the intestine of animals was shown by Hegner (Am. Jl. Hyg., 3: 180–200, 1923), Ratcliffe (Am. Jl. Hyg., 10: 643–654, 1928) and Schumaker (Am. Jl. Hyg., 12: 341–365, 1930), who demonstrated that diets high in protein reduced the number of trichomonads in the intestine of rats, and even eliminated in these animals experimental infections with balantidia. Andrews and Paulson (Jl. Lab. & Clin. Med., 16: 39, 1930) found that the administration of barium sulphate, increasing the crystalloid contents in the intestine of man, brought about a reduction in the number of protozoa present as shown by a decrease in the incidence on stool examination. Hegner and Eskridge (Am. Jl. Hyg., 21: 135–150, 1935) increased the viscosity of the intestinal contents of rats by adding to their diet agar-agar, gum arabic and psyllium seed; they found that the number of trichomonads present was appreciably diminished.

In this note are presented experiments that were made in order to ascertain if an increase in the viscosity of the intestinal contents of rats, or if an increase in its crystalloids, would bring about a numerical decrease in the number of balantidia in experimental infections in these animals with a pure line of *Balantidium coli* from the chimpanzee.

Since a diet rich in carbohydrates is required to produce infections with *B. coli* in rats (Schumaker, *ibid.*) the following diet was used throughout these experiments: whole wheat flour 85%, casein 5%, butter fat 5%, calcium carbonate 2%, ferric citrate 2% and sodium chloride 1%. The strain of balantidia used infected 88.1% of the rats maintained on this diet (Gabaldon, Jl. Parasit., 20: 331–332, 1934). In order to increase the viscosity of the intestinal contents of the rats, to each three portions of this high carbohydrate diet was added one portion of agar-agar, linseed or psyllium seed in powder form. To increase the crystalloid contents one part of barium sulphate or bismuth subcarbonate was added to 9 parts of the mentioned diet.

The experimental rats, of approximately the same weight, were given the high viscosity or the high crystalloid diets for seven days previous to the infection with balantidia. The control animals were given only the high carbohydrate diet for the same period before infection. In each trial two groups of rats were used, nine experimental and nine control. They were inoculated intracecally after laparotomy the same day with the same number of balantidia (1000 trophozoites approximately) of the same origin. The same number of experimental and control animals were killed between the third and ninth day after inoculation and the ciliates of the whole large intestine were counted with a technique described previously (Gabaldon, Jl. Parasit., 21: 386–392, 1935). In the high viscosity diets the average numbers of balantidia per centigram of large intestine and contents for the experimental and control rats were: with the agar-agar diet 60.4 and 347.4, with the linseed diet 92.7 and 314.4, with the psyllium seed diet 34.2 and 48.4, respectively. In the high crystalloid diets the average numbers of trophozoites in the experimental and control animals were: with the barium sulphate diet 136.4 and 235.5 and with the bismuth subcarbonate diet 235.6 and 77.9, respectively. The difference between the numbers of balantidia in experimental and control animals was not statistically significant, which indicated that these high viscosity and high crystalloid diets had not affected the numerical population of the ciliates in the large intestine of rats. The numbers given above

indicate that with every experimental diet except bismuth subcarbonate there was apparently a considerable decrease in the balantidial population. The difference between the number of balantidia in experimental and control rats was not statistically significant, probably because of the great numerical variation of the ciliates in both groups of animals.

In conclusion, experiments made with a total of 90 rats, 45 experimental and 45 control, showed that the numerical population of *B. coli* in artificially produced infections in the large intestine of these rodents, is not affected significantly by increasing the viscosity of the intestinal contents of the hosts with agar-agar, linseed or psyllium seed, or by increasing the crystalloid portion of these contents with barium sulphate or bismuth subcarbonate.—Arnoldo Gabaldon, *Department of Protozoology, School of Hygiene and Public Health, Johns Hopkins University, Baltimore, Md.*

ATTEMPTS TO INFLUENCE A COCCIDIAN INFECTION NEGATIVELY THROUGH THE DIET

The purpose of this note is to record briefly certain negative results from attempts to limit the coccidian population in rats infected with *Eimeria miyairii* by supplementing the normal or growing diet with chemical substances, in some cases of known insecticidal or anthelminthic value. The method employed in all cases was as follows: the rats were put on the test ration; on the next and four succeeding days they were infected with 1500 sporulated oocysts of *Eimeria miyairii*; the pellets containing the oocysts were collected from the beginning of oocyst elimination until it ceased, and the approximate number of oocysts was determined by the dilution and counting method. Control rats of the same number as the test rats were given identical treatment except that the ration contained no chemical supplement. The rats were kept in individual cages with wire mesh bottoms over pans containing an aqueous disinfectant from the seventh to the fourteenth day of the infection, by which time the infection had run its course.

Comparisons of the total numbers of oocysts eliminated by test and control series gave definite indication that the following materials were ineffective in retarding the development of the coccidium in the rat when given in the ration in the proportions stated: nicotine worm powder, 3.3% mixture; derris, 0.5% mixture; pyrethrum, 0.55% mixture; calomel, 0.1% mixture; calomel, 0.3% mixture; sodium bicarbonate in 3.2%, 4.0%, and 5.05% mixtures; calcium carbonate, 8.5%; calcium chloride, 2.0%; disodium phosphate, 0.4%; and creolin, 3 cc. of 0.25% solution given daily through a catheter.

These experiments, as well as those previously reported by Becker and Morehouse (1935, Proc. Soc. Exper. Biol. and Med., 32: 1030–1031), lend support to the belief of the writers that limiting the population of coccidia through supplements to the diet and drugs will prove very difficult.—Elery R. Becker and Philip S. Spencer, Iowa State College.

A NOTE ON *TRYPANOSOMA MICROTI*

The examination of some blood smears from the short tailed meadow mouse, *Microtus pennsylvanicus* (Ord.), during the spring of 1935, revealed trypanosomes which have been determined as *Trypanosoma microti*. Laveran and Pettit (1909, C. R. Soc. Biol., 2: 798–800) first described this parasite from *Microtus arvalis* Pallas in France and designated the form as belonging to the *T. lewisi* type and measuring 25–30 μ in total length: width 1.5 μ and the flagellum 6–7 μ long. Lavier, also working in France, reported finding *T. Microti* again in 1921 (Bull. Soc. Path. Exot., 14: 569–576) for which he gives the following measurements: (1) posterior end to parabasal body, 4 μ; (2) parabasal body to middle of nucleus, 7 μ; (3) middle of nucleus to anterior end, 9–11 μ; (4) anterior end

to tip of flagellum, 6–8 μ; (5) total length, 30–37 μ. The writer's measurements, using the average of twenty specimens, are: (1) 3.77 μ; (2) 7.95 μ (3) 9.58 μ (4) 8.60 μ; (5) 29.93 μ; width midway between nucleus and parabasal body, 1.55 μ.

Since the parasites reported here agree with the description given by the initial describer and also agree with the work of Lavier—except in the measurement of total length and his measurement, of total length, does not agree with the original description either—the writer feels that he is dealing with *T. microti.* The French workers examined numerous animals and report finding the trypanosomes only in small numbers and never any forms in division. The blood of the mouse examined by the writer showed rather large numbers of *T. microti* but no division forms were seen.

This is a new host-record and also the first time this parasite has been reported from North America, unless the form seen by Stabler and reported by Wenrich (1935, Uni. Penn. Bull.—Sch. Vet. Med., 35(58) : 3–8) host species not stated, might prove to be *T. microti.*—G. Robert Coatney, *State Teachers College, Peru, Nebraska.*

A NOTE ON THE LIFE HISTORY OF THE MONOSTOME, *NOTOCOTYLUS URBANENSIS*

The snails, *Stagnicola emarginata angulata, Physella parkeri,* and *P. magnalacustris,* of the University of Michigan Biological Station area yielded monostome cercariae upon isolation in the laboratory. These cercariae emerged from the snails and encysted almost immediately upon lettuce or the sides of the isolation bottle. The forms from these three molluscan hosts appeared to be the same species and were identified as *Cercaria urbanensis* described by Cort (Jour. Parasit., 1: 65–84, 1914). This is a form with eye spots which possesses a *U*-shaped excretory bladder and two posterior adhesive organs which aid in locomotion. Some of these encysted cercariae were fed to four hooded mice, a white-footed mouse (*Peromyscus leucopis*), to a young muskrat and to three domesticated ducklings raised in the laboratory. Eleven days after being fed fifty cysts of the cercariae from *Physella magnalacustris,* the laboratory muskrat yielded six young adult Monostomes measuring 0.511 mm. in length and 0.227 mm. in width which were apparently *Notocotylus urbanensis*; however, the identification of these immature forms was not final in that the characteristic of three or five longitudinal rows of ventral cuticular glands which distinguish *N. urbanensis* from *quinqueserialis* was undeveloped. Besides these ventral cuticular modifications and the relative position of the genital pore, there is very little morphological difference between these two species. Twenty-five days after one of the ducklings ingested fifty cysts of the cercariae from *Stagnicola emarginata angulata,* two adults of *Notocotylus urbanensis,* which contained ova and measured 3.48 mm. in length and 0.68 to 1.24 mm. in width, were found in the cecum of the bird. These data are an experimental demonstration that *C. urbanensis* is the larva of *Notocotylus urbanensis* and confirms Harrah's (1922) supposition that this was so because of morphological comparison of the encysted cercariae and the young adults he found infecting pin-tails, wood-ducks, and muskrats.—George W. Luttermoser, *Department of Helminthology, Johns Hopkins School of Hygiene and Public Health.*

REVIEWS

GAY, FREDERICK P., AND ASSOCIATES. Agents of Disease and Host Resistance. Including the Principles of Immunology, Bacteriology, Mycology, Protozoology, and Virus Diseases. Charles C. Thomas, 1935. XIII, 1581 pp. Price $10.00.

This attempt to bring together under one cover the essential information on (to use the senior author's words) "the etiology of disease" is well conceived and well outlined. The 65 chapters in the book are divided into 12 more or less natural parts: I. General aspects of the causation, classification, and nature of disease; II. Inanimate disease agents and tolerance; III. Living disease agents, particularly bacteria; their morphology and physiology; IV. Infection and epidemiology; V. Resistance and immunity; VI. Pathogenic bacteria and diseases produced by them; VII. Pathogenic spirochetes and spirochetoses; VIII. Pathogenic fungi and fungus diseases; IX. Indeterminate pathogenic forms and diseases produced by them; X. Animal Pathogens; XI. Diseases of obscure etiology; XII. Practical results in the diagnosis, prevention and cure of infectious disease. It is because of the inclusion of Part X that the book is reviewed in this Journal.

In Part X covering the field of parasitology the several authors have evidently made a definite effort to review the current literature. Extensive bibliographies are appended to each chapter. For the most part, however, relatively little is given beyond what has been given or would be expected in any parasitological text. In the chapters on helminthology the attempt to include domestic animals parasites is incomplete. This book should, if its title is to be taken literally, have offered an admirable opportunity to summarize the great body of literature dealing with the evidence and nature of host resistance to parasitic infections. The extensive experimental studies on bird malaria, trypanosomiasis, coccidiosis, trichinia, dog hookworm, *Nippostrongylus muris* in rats, *Cysticercus fasciolaris* in rats, and others might have been utilized more extensively to illustrate the principles involved. It is inevitable that errors should creep into any first edition and the following are some of those noted by the reviewer. On page 1295 all the pathogenic flagellates are said to be confined to two genera, *Trypanosoma* and *Leishmania*. No mention is thus made of intestinal flagellates suspected of pathogenicity or two tissue invading Trichomonads which are clearly pathogenic. On pp. 1332–33 the trematode *Troglotrema salmincola* is indicated as the etiological agent of salmon poisoning in dogs. On page 1374 the misinterpretation of the reason why birds are refractory to trichina infection is apparently due to the author's not having seen Augustine's report on the infectability of trichina for chickens. On page 1389 the implication that pinworms live extensively in the small intestine and thus create a special problem in therapeusis is misleading. The one anthelminthic, so far as the reviewer is aware, which has been shown to be effective for this worm *under controlled conditions* is not mentioned. In a later chapter on page 1557 the inadequate discussion of anthelminthics is not up to date and might better have been omitted.

On the whole the chapter on Entomology is very well handled but it is unfortunate that there should occur both in the table (112) and text (pp. 1432–1433) the implication that the house fly is a vector of consequence of the intestinal protozoa but more particularly of the intestinal helminths; specifically listed are *Taenia solium, T. (Echinococcus) granulosa, Ascaris lumbricoides, Trichuris trichiura,* and hookworm and Strongyloides larvae.

Despite the criticisms made the reviewer feels that the inclusion of this parasitological material has added to the value of the book.—G. F. OTTO.

BRIEF DIRECTIONS IN HISTOLOGICAL TECHNIQUE. By Elery R. Becker and Robert L. Roudabush, Department of Zoology, Iowa State College. Collegiate Press, Inc., Ames, Iowa, 1935.

This little manual was prepared especially for use by classes in histological technique in the Zoology and Entomology Department at Iowa State College. It includes the simple essential procedures for the inexperienced student. For more elaborate methods the student is referred to more extensive works, references to which are given in Chapter I. Chapter VIII includes methods of particular interest to the parasitologist, such as the technique of making toto mounts of parasitic protozoa and helminths.—W. W. Cort.

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